PALÆONTOGRAPHICAL SOCIETY.

BRITISH FOSSIL ECHINODERMATA

FROM

THE OOLITIC FORMATIONS.

PART FOURTH.

THE ECHINOLAMPIDÆ, THE STRATIGRAPHICAL DISTRIBUTION OF THE OOLITIC SPECIES, THE BIBLIOGRAPHY OF THE ECHINODERMATA, AND ADDITIONAL NOTES ON THE ECHINOIDEA.

THE EOCENE MOLLUSCA.

PART III.—No. III.

PROSOBRANCHIATA

(CONTINUED).

THE FOSSIL REPTILIA

OF THE

CRETACEOUS AND PURBECK STRATA;

INCLUDING

SUPPLEMENT No. III.

CRETACEOUS PTEROSAURIA AND SAUROPTERYGIA.

SUPPLEMENT No. II.

IGUANODON AND PURBECK LACERTILIA.

BRITISH CARBONIFEROUS BRACHIOPODA.

PART V.

THIRD PORTION.

ISSUED FOR 1858.

California Academy of Sciences

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NOTE

TO

THE CRAG MOLLUSCA.

In the Appendix to the 'Crag Mollusca,' p. 323, is the notice of a fossil which I have there assigned, with doubt, to the Genus Aplysia, conceiving it to have been the calcareous portion of an internal shell; and as it is important that errors of this kind should not remain uncorrected, I take the earliest opportunity of making the correction. In the living Aplysia there is a shell or shield situated on the back of the animal, encysted in the mantle, covering the branchial region; and although this internal shell in the recent state is thin and coriaceous, I thought it possible there might be sufficient calcareous matter in the shell of some species of that genus to permit its being preserved in a fossil state. In this I have been mistaken. Considerable doubt was entertained by me at the time of publication, but it was my desire to have everything figured that appeared to be in any way connected with the Mollusca of the Crag.

In the course of my examination of the Eocene Bivalves, now preparing for publication, my attention has been directed to the Genus Anomia, and I find there that the right or under valve is sometimes so small as almost to be obsolete or useless as a protection to the living animal, the diameter of the upper valve being in some instances three times that of the lower, and the construction of this latter is often so thin and fragile as to permit the greater part of it to be easily destroyed. From the umbonal region of this valve, proceeding towards the larger side in the interior of the shell, are two thickened ridges, one forming the dorsal margin and the other extending downwards to the body of the shell immediately on the hinder edge of the foramen, which gives a strength and protection to this part of the valve over the

other, and this is the state and condition of the specimens of my little Crag fossil, the correct position of which I had been unable to determine; the figure, therefore (fig. 24, Pl. XXXI) will serve as an illustration of the under valve of what probably was the young state of the Crag *A. ephippium*.

There is every reason to believe that the Genus Aplysia existed during the Tertiary Period, but as yet it appears we have no well-attested specimens of their remains having been preserved in a fossil state.

S. V. WOOD.

May, 1860.

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BY

C. DARWIN, M.A., F.R.S., &c.

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A MONOGRAPH

ON THE

BRITISH FOSSIL

ECHINODERMATA

FROM

THE OOLITIC FORMATIONS.

BY

THOMAS WRIGHT, M.D., F.R.S.E. F.G.S.

CORRESPONDING MEMBER OF THE ROYAL SOCIETY OF SCIENCES OF LIÉGE,
AND SURGEON TO THE CHELTENHAM HOSPITAL.

PART FOURTH,

CONTAINING

THE ECHINOLAMPIDÆ,
THE STRATIGRAPHICAL DISTRIBUTION OF THE OOLITIC SPECIES,
THE BIBLIOGRAPHY OF THE ECHINODERMATA, AND
ADDITIONAL NOTES ON THE ECHINOIDEA.

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Geology
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Genus—PYGURUS, *d'Orbigny*, 1855.

ECHINANTHITES, *Leske*, 1778.
CLYPEASTER (pars), *Lamarck*, 1801.
ECHINOLAMPAS (pars), *Agassiz*, 1836.
PYGURUS (pars), *Agassiz* 1840.
PYGURUS, *d'Orbigny*, 1855.
PYGURUS, *Desor*, 1858.

The genus *Pygurus*, as now limited, is composed of large, discoidal, or clypeiform urchins, in which the test in general is more or less enlarged at the sides, and rostrated posteriorly; its upper surface is usually depressed, and rarely elevated.

The ambulacral areas and poriferous zones in the upper surface form petaloidal expansions, which have an elegant form, being in general contracted at the border, enlarged in the middle, and attenuated at the apex. The anterior single area is narrower than the antero- and postero-lateral areas; the summit is in general central, or slightly excentral, the inclination being always forwards.

The base is concave and much undulated, the wide basal inter-ambulacra swell into prominent cushions, and the narrow ambulacra form narrow valleys between them.

The mouth-opening is pentagonal, and always excentral; the peristome is surrounded by five prominent lobes, with which five expanded ambulacral petals alternate; in the poriferous zones near the mouth the pores are closely crowded in triple oblique ranks; these perforated petals form an oral rosette or a penta-phylloid floscule (Pl. XXXVII, fig. 1 *b*, *e*).

The vent is infra-marginal; it is in general oval, and surrounded by a distinct area, which occupies the rostrated portion of the single inter-ambulacrum; the long diameter of the opening in general corresponds with the longitudinal axis of the test, although it is sometimes transverse (Pl. XXX, fig. 2 *b*).

The apical disc is very small, and occupies the summit; it is composed of two pairs of narrow, perforated, and a single rudimentary imperforate, ovarial plate; five minute ocular plates, with central eyeholes, are interposed between the ovarials (Pl. XXXV, fig. 3). The small madreporiform body is attached to the surface of the right anterior ovarial, and forms thereon a spongy eminence, which extends over the other discal elements (fig. 3 *g*).

The tubercles are very small on the upper surface, but larger at the base; they are surrounded by sunken areolas, have their summits perforated, and the inter-tubercular space covered with close-set miliary granules (Pl. XXXV, fig. 2 *e*, *g*).

PYGURUS MICHELINI, *Cotteau*. Pl. XXXV, fig. 2 *a*, *b*, *c*, *d*, *e*, *f*, *g*.

PYGURUS	MICHELINI.	Cotteau, Études sur les Échinides Foss. de l'Yonne, p. 70, pl. v, fig. 7, 1849.
—	PENTAGONALIS.	Wright, Ann. and Mag. of Nat. Hist., 2d ser., vol. ix, pl. iv, fig. 3, p. 313, 1851.
—	—	Forbes, in Morris's Catalogue of British Fossils, 2d ed., p. 88, 1854.
—	MICHELINI.	D'Orbigny, Pal. Franç. ter. Crétacés, t. vi, p. 301, 1855.
—	DAVOUSTIANUS.	Davoust., Note sur les Foss. spéciaux à la Sarthe, p. 6, 1856.
—	MICHELINI.	Desor, Synopsis des Échinides Fossiles, p. 315, 1857.
—	—	Cotteau et Triger, Échinides du département de la Sarthe, pl. xiii, figs. 1—5, p. 65, 1858.

Test oval, or sub-pentagonal, very slightly indented before and rostrated behind; upper surface convex, under surface concave, with prominent, cushioned, basal inter-ambulacra; apical disc nearly central; ambulacral areas and poriferous zones widely petalloid on the upper surface, contracted at the lower fifth, and lanceolate at the apex; inter-ambulacra with two flat ridges, which in each area extend from the disc to the mouth; vent elliptical, infra-marginal, lodged in a deep anal depression, with inclining sides; mouth-opening large, pentagonal, excentral; peristome surrounded by five prominent oral lobes and five depressed phylloidal floscules.

Dimensions.—Height, one inch and one tenth; antero-posterior diameter, three inches and one tenth; transverse diameter, three inches and one tenth.

Description.—The first specimen of this *Pygurus* I obtained was an elongated subpentagonal variety, resembling in outline some of the Yorkshire specimens, and which I erroneously referred, in my 'Memoir on the Cassidulidæ of the Oolites,' to *P. pentagonalis*, Phil.; since that time I have collected a very fine series of this urchin, which I have carefully compared with M. Cotteau's beautiful figures, and have no hesitation in referring them to *Pygurus Michelini*, Cott. Our English examples are larger than those from the Sarthe, but in all the details of their anatomy they are identical with that form.

The test is nearly orbicular; in some specimens it is longer than broad, flattened, or slightly concave before, and produced or rostrated behind; the upper surface is convex, and rises to a prominent vertex (fig. 2 *c*, *d*), which is sub-central, and from which the sides decline unequally; in consequence of the prominence of the single ambulacrum, the posterior side forms a more regular inclined plane than the anterior side (fig. 2 *d*); the border is very much undulated, and the base concave.

The ambulacral areas are widely petalloid on the upper surface, narrow at the border and base, and again expanded near the mouth; they are sharply lanceolate at the apex, and closely approximated at the disc (fig. 2 *a*); the poriferous zones on the upper surface are formed of an inner row of round holes and an outer row of oblique, slit-like apertures.

the length of which gradually diminish from the middle of the petal upwards to the apex, and downwards to about the lower fifth of the area, where the oblong pores are reduced to simple pores, like those of the inner row (fig. 2 *d*); at the border the pairs of pores lie close together, at the base they are much wider apart (fig. 2 *b*), and about half an inch from the mouth they again greatly increase in number, and in the depressed phylloidal floscule form a regular series of triple oblique pairs (fig. 2 *b*), with twelve rows in each zone.

The inter-ambulacral areas are uniformly convex above, the postero-lateral and single inter-ambulacrum are of the same width, and the anterior pair are narrower at the under surface; these segments form prominent cushions, which are very tumid at the border, but less so near the mouth; the most prominent part of each cushion is flattened at the interspace between the ridges which radiate from the disc to the mouth.

The single inter-ambulacrum is produced, rostrated, and deflected; at its infra-marginal border is a deep anal depression, with prominent and inclined sides, at the bottom of which the elliptical anus opens (fig. 2 *b*); the anal valley indents the border, and forms a conspicuous notch in the margin when the test is viewed from behind forwards, as is well shown in fig. 2 *c*, which likewise exhibits the undulations of the base.

The apical disc is remarkable for the size of the madreporiform body and the smallness of the genital plates (fig. 2 *f*); the anterior pair are less than the posterior pair, and the four are perforated; the single plate is posterior, and imperforate (fig. 3); the small rhomboidal ocular plates alternate with the genitals, the very minute eyeholes are perforated in the centre of the plates; the madreporiform body rises from the surface of the right antero-lateral genital, extends over the surface of all the others, and occupies the centre of the disc (fig. 3).

The large mouth-opening is sub-central and forward; the peristome is pentagonal, and surrounded by five prominent oral lobes (fig. 2 *b*); alternating with them are the five depressed phylloidal terminations of the ambulacra, in which numerous pores are arranged in triple oblique rows; this crowding together of the pores in regular order, imparts an ornamental character to the five oral ambulacra.

The tubercles on the upper surface are very small, on each plate they are arranged in four or five tolerably regular horizontal rows, and surrounded by sunken areolas; the inter-tubercular surface is covered with microscopic granules, placed so close together that all the intermediate portion of the plates, when examined with a low magnifying power, is seen to have a finely sculptured appearance. At the base the tubercles are larger, and disposed with less regularity; they increase in size, and are set closer together at the border and on the convex surface of the five basal cushions, whilst they are still larger and placed wider apart near the mouth-opening and on the sides of the ambulacra.

Affinities and differences.—This species has been frequently confused with *Pygurus depressus*, Ag., which it very much resembles; according to M. Cotteau, it is distinguished

from that species by the following characters, "Par sa forme plus oblongue, plus allongée, par ses ambulacres relativement plus larges, se rétrécissant moins brusquement et logés, aux approches du péristome, dans des sillons plus droits et plus prononcés, par sa face inférieure moins déprimée. Ces deux espèces caractérisent d'ailleurs un horizon différent ; le *Pygurus Michelini*, propre aux couches de la Grande Oolite, se rencontre associé à *l'Echinobrissus clunicularis*, au *Collyrites ovalis*, à *l'Hyboclypus gibberulus*, tandis que le *Pygurus depressus* se trouve dans le Kelloway ferrugineux avec le *Collyrites elliptica*, *l'Echinobrissus Goldfussii*, le *Pseudodiadema Calloviense*, etc."*

Pygurus Michelini, Cott., resembles *Pygurus pentagonalis*, Phil., in its general outline ; the former, however, is more depressed on the upper surface and more undulated at the base, the anterior border is more concave, and the single inter-ambulacrum more rostrated and deflected.

Locality and Stratigraphical position.—I found one small example of this species in the Great Oolite at Minchinhampton, where it is excessively rare. I have collected beautiful specimens in the Cornbrash near Trowbridge, Wilts, and my kind friend, the Rev. A. W. Griesbach, presented me with the magnificent specimen figured at Pl. XXXV, which he obtained from the Cornbrash at Rushden (Northamptonshire). I have two inferior specimens from the Cornbrash near Yeovil. The specimen of this species I first figured was said to have been found in the Lower Trigonia Grit (zone of *Ammonites Parkinsoni*) at Shurdington Hill, near Cheltenham. This urchin has been collected from a marly bed of Cornbrash near Fairford; it was found by my friend, J. Lowe, Esq., in the Cornbrash at Wincanton (Somerset), and I have seen specimens which were obtained from the Bradford clay at Bradford, Wilts. It seems therefore that the range of this species, like many other Echinodermata which first appeared in the zone of *Ammonites Parkinsoni*, Inferior Oolite, extended onwards through Fuller's earth, Great Oolite, Bradford clay, and Forest marble, into the Cornbrash, in which formation they all became extinct.

The foreign distribution of this *Pygurus* is the same as in our English Oolites. M. Bouchard-Chantereaux kindly sent me a specimen which he collected from the Great Oolite near Boulogne-sur-Mer.

It has been collected by M. Triger at "Monné (carrière de Bernay), La Jaunelière, Hyéré, Noyen, Pécheseul, route de Coutilly, route de Suré à Mortagne.

"Tabl. de M. Triger, Bradford Clay, Ass. No 1, et Forest marble, Ass. No. 4."

It has been found by M. Cotteau in the "Grande Oolite de Asnières, Châtel-Gérard (Yonne)," and by M. Desor in the "Marnes Vésuliennes du Jura Soleurois et Argovien."†

* Cotteau et Triger, 'Échinides du département de la Sarthe,' p. 67.

† Ibid. Ibid. p. 67.

PYGURUS PENTAGONALIS, *Phil.* Pl. XXXVI, fig. 1 *a*, *b*, *c*, *d*; fig. 2 *a*, *b*.

ECHINANTHITES ORBICULARIS.	Young and Bird, Geol. Surv. of Yorksh. Coast, pl. vi, fig. 5, p. 213, 1822.
CLYPEASTER PENTAGONALIS.	Phillips, Geology of Yorkshire, pl. iv, fig. 24, 1829.
ECHINOLAMPAS PENTAGONALIS.	Morris, Catalogue of British Fossils, p. 52, 1843.
PYGURUS PENTAGONALIS.	Forbes, in Morris's Catalogue of Brit. Fossils, 2d ed. p. 8, 1854.
— —	Desor, Synopsis des Échinides Fossiles, p. 314, 1858.

Test sub-pentagonal, emarginate, and concave anteriorly, wide in the middle, produced, and deflected posteriorly; upper surface convex, with a conical vertex, ambulacral areas and poriferous zones widely petalloid in the upper two thirds of the dorsal surface, and very narrow in the lower third; apical disc small, central, forming the vertex of the test; under surface concave; basal inter-ambulacral cushions moderately prominent; mouth-opening small, sub-central, forwards; peristome pentagonal, with five mammillated oral lobes and five narrow ambulacral phylloidal floscules; vent elliptical, infra-marginal, situated in a deep anal valley.

Dimensions.—A. Height, one inch and four tenths; transverse diameter, three inches and three quarters; antero-posterior diameter, three inches and nine tenths.

B. Transverse diameter, three inches and a half; antero-posterior diameter, three inches and four tenths.

C. Height, one inch and one fifth; transverse diameter, three inches; antero-posterior diameter, three inches.

Description.—I have given the measurements of three different Yorkshire specimens of this *Pygurus*. The specimen A was collected from the Coralline Oolite at Hildenley, near Malton, by C. W. Strickland, Esq.; the specimen B was obtained near Scarborough, and belongs to the Scarborough Museum; and the specimen C was collected from the Lower Calcareous Grit near Scarborough. The examples from the Coralline Oolite are in general much larger than those found in the Lower Calcareous Grit.

The test has an orbicular or sub-pentagonal form; the anterior border is emarginate and concave; the antero-lateral border expands outwards to the middle of the test, where its greatest diameter is attained. The postero-lateral border slopes inwards and backwards, and forms a rostrated and deflected termination. This is the form of the urchin figured in fig. 1 *a*, *b*, from the Calcareous Grit, which may be taken as a type of the species. In the one from the Coralline Oolite (fig. 2 *a*) the test is altogether orbicular, and more convex.

The ambulacral areas are remarkably petalloid (fig. 1 *a*) on the upper surface, the lower third of the area is very narrow, the middle third much expanded, and the upper third

lanceolate. The poriferous zones on the dorsal surface are formed of an inner row of oblong holes, and an outer row of oblique, slit-like apertures, both rows being conjugate through very fine sulci (fig. 2 *b*); at the lower fourth of the zone the slit-like outer pores contract into simple pores like those of the inner row; at the border the pairs of pores lie close together, whilst at the base they are wide apart; near the mouth-opening the ambulacra form phylloidal expansions, in which the pores lie crowded in triple, oblique pairs; the mammillated character of the oral lobes occasions a considerable contraction of the areas around the peristome (fig. 1 *b*).

The inter-ambulacral areas on the upper surface are uniformly convex; the anterior pair are narrower than the posterior pair; the single area, which is about the same width of the latter, is produced, rostrated, and deflected (fig. 1 *c*), and in some varieties forms a caudal prolongation; at the under surface, which is concave, the basal inter-ambulacra are moderately convex; the postero-lateral pair and single inter-ambulacrum are more so than the anterior pair; the anal valley is deep, with inclined sides, and the vent is large and elliptical (fig. 1 *b*).

The mouth-opening is small, sub-central, and forwards; it lies at the most concave part of the base; the peristome is pentagonal, and the five oral lobes, formed by the terminations of the inter-ambulacra, have a prominent, mammillated character, which occasions a contraction of the ambulacra at the point where they join the peristome; the protrusion of the lobes removes the mouth itself far from the surface; the emargination of the anterior border is more conspicuous at the base, and the anteal sulcus occasions a considerable depression in the anterior border.

The tubercles are very small, and arranged in close-set rows, of which there are five or six on each plate (fig. 2 *b*); the areolas are well defined; the tubercles at the base are much larger than those on the upper surface; they are more developed at the border, on the declining sides of the cushions, and near the mouth, than on the convex surface of these prominences, where they are small and closely aggregated together; the tubercles here are distinctly perforated (Pl. XXXV, fig. 2 *g*), whilst the intermediate surface is covered with close-set microscopic granules. Few portions of the specimens I have seen are sufficiently well preserved to show the sculpture; in those from the Calcareous Grit it is almost always effaced, whilst in those from the Coralline Oolite it is concealed by the Oolitic Coralline mud in which the most of them is enveloped.

The apical disc is small and central (fig. 1 *d*); the madreporiform body, which is round, convex, and prominent, forms the vertex, the large ambulacral petals covering nearly all the other portion of the upper surface. In fig. 1 *c* the dorsum forms a conical eminence through the development of the petals and disc (fig. 1 *a*).

Affinities and differences.—This species so closely resembles *Pygurus Michelini*, Cott., that it is only after a careful analysis of its specific characters the differences between them are discovered. *Pygurus pentagonalis* is more convex on the upper surface, and more con-

cave at the base; the ambulacral petals on the dorsal surface are petalloid only in the upper two thirds of their length, and very narrow and graceful in the lower third of the areas (fig. 1 *a*, *c*; fig. 2 *a*); the anterior border is emarginate and concave, and the under side is impressed by the anteal sulcus; the posterior inter-ambulacrum is rostrated and deflected; the mouth-opening is small, and the oral lobes large and prominent. When these characters, which are permanent in all the examples I have examined, are compared with the homologous parts in *Pygurus Michelini*, which have been already described, the distinction between the species will be readily determined. (Compare Pl. XXXV and XXXVI.)

Locality and Stratigraphical position.—I have collected this urchin from the Lower Calcareous Grit at Bullington-green, near Oxford, at Farringdon, Berks, from the same rock at Scarborough, Castle Hill, and Gristhorpe Bay, on the Yorkshire coast. It is likewise obtained from the Coralline Oolite at Scarborough and Ayton, and at Malton and Hildenley; from the latter locality I have been enabled to study a fine large specimen, kindly presented to me by C. W. Strickland, Esq., and beautifully developed by him. My kind friend, John Leckenby, Esq., communicated the beautiful specimen figured in Pl. XXXVI, fig. 2 *a*, which came from the Coralline Oolite of Malton, and belongs to the Scarborough Museum. The small specimen (fig. 1 *a*, *b*) was collected by my friend, Dr. Murray, of Scarborough, from the Lower Calcareous Grit, near that town, and generously given to me by him for this work; *Pygurus pentagonalis* is, therefore, a true Corallian form, and a most characteristic urchin of this formation, both in the Midland Counties as well as in Yorkshire.

Pygurus costatus, *Wright*, nov. sp. Pl. XXXVII, fig. 1 *a*, *b*, *c*, *d*, *e*, *f*.

Test sub-pentagonal, discoidal, much depressed at the upper surface; ambulacral petals large, costated, extending over four fifths of the upper surface; anterior border flat, emarginate; posterior border rostrated; postero-lateral border very thin; apical disc excentral, forwards; base flat; mouth-opening large, sub-central; peristome surrounded by five large oral lobes and five spoon-shaped phylloidal floscules.

Dimensions.—One large specimen.—Height, one inch and one tenth; transverse diameter and antero-posterior diameters, equal, four inches.

Specimen, Pl. XXXVII.—Height, nineteen twentieths of an inch; transverse diameter, three inches and three tenths; antero-posterior diameter, three inches and three tenths.

Description.—This urchin is remarkable for its discoidal form and for the prominent, costated character of its dorsal ambulacra; the anterior border is flat, the sides form obtuse angles near the middle of the disc, and the posterior border is rostrated, but not deflected;

the upper surface is very much depressed, and remarkable for the costated character of the ambulacral areas, which are widely petalloid four fifths of the distance between the disc and border (fig. 1 *a*). The poriferous zones consist of an inner row of oblong pores, and an outer row of oblique, slit-like pores, conjugate throughout by fine sulci (fig. 1 *d*); the transverse pores are separated by thin septa, on the surface of which a series of minute granules are arranged; there are from seven to nine pair of pores opposite each large inter-ambulacral plate (fig. 1 *d*). Near the border the pores are simple, and set close together; they continue so round the marginal fold; at the base they are placed wide apart, from their ambulacral plates being large and rhomboidal; on the outer two thirds of these segments, near the mouth, the areas suddenly expand (fig. 1 *b*), and between the oral lobes they again as suddenly contract, forming thereby spoon-shaped depressions around the mouth (fig. 1 *e*). On the sides of these depressions the poriferous zones present a remarkable development (fig. 1 *e*); the pores form three crescentic rows on each side of the depression, between the single pair and the marginal contraction (fig. 1 *e*). The lobes are very large and mammillated, and form considerable eminences around the mouth, their lip-like forms extending over the border of the peristome (fig. 1 *f*).

The inter-ambulacral areas are of unequal width; the antero-lateral pair are the narrowest, the single posterior rostrated area the widest, and the postero-lateral pair of intermediate dimensions; their upper surface is almost uniformly sloped, and their basal portions extremely flat; in most Pyguri the prominence of the inter-ambulacral cushions might be considered a generic character; in this species, however, the convexity of these basal segments is very inconsiderable (fig. 1 *c*).

The mouth-opening is large and sub-central, nearer the anterior border; the peristome is pentagonal, and surrounded by five mammillated prominent lobes, which project, with lip-like processes, over the oral opening (fig. 1 *b*, *f*); between the lobes the ambulacra are much contracted, and beyond the lobes they form wide phylloidal expansions, on the sides of which the poriferous zones consist of three concentric rows of holes (fig. 1 *e*); the structure of the oral lobes, phylloidal ambulacra, and trigeminal pores, form the most remarkable features in this disciform species.

The apical disc is small and sub-central, it forms the vertex of the test (fig. 1 *c*), and the centre of a conoidal elevation, occasioned by the costated character of the ambulacral areas; the disc consists of four small perforated genital, a single imperforate genital, and five very small ocular, plates; the small madreporiform body rises from the surface of the right antero-lateral genital, covers the surface of the other plates, and forms a round spongy prominence in the centre of the disc (fig. 1 *a*).

The dorsal tubercles are very small, and arranged in four or five rows on each plate; they are surrounded by well-defined sunken areolas, and all the intermediate surface is occupied by microscopic miliary granules, which are likewise encircled by sunken areolas; when viewed with an inch object-glass, the plates are seen to possess a delicately sculptured surface (fig. 1 *a*); the basal tubercles on the sides of the inter-ambulacra, and the convex part

of the lobes are fewer in number, and larger in size (fig. 1 *b*), than those of the dorsum, and their surface is perforated; the tubercles on the convex portions of the inter-ambulacra are very small, and placed so close together that the borders of the areolas form hexagonal figures; the basal ambulacra are destitute of tubercles, and the plates are covered only with miliary granules; the nakedness of the surface clearly displays the size of the plates, and their peculiar figure, with the distant pores in the narrow zones in this region of these segments.

The oblong vent is infra-marginal, and the anal valley is shallow, with sloping sides, on which some larger tubercles are disposed.

Affinities and differences.—This species resembles *Pygurus orbiculatus*, Leske, so beautifully figured by M. Cotteau; *Pygurus costatus*, however, has a much larger test, it is more depressed at the upper surface, and has more prominent, costated, ambulacra; the pentagonal border, is more rostrated behind, and more emarginate before; the larger mouth-opening has more prominent lobes and larger phylloidal ambulacra, and the test presents an ensemble of characters by which these two allied forms may readily be distinguished.

Pygurus costatus resembles *Pygurus Marmonti*, Beaud., from the Kelloway ferrugineux of the Sarthe, in the general disciform shape of the test and flatness of the base, but in the specimen of *P. Marmonti* before me the poriferous zones are petaloid to the border, the vent is removed inwards some distance from the margin, and the test has, moreover, an orbicular circumference.

The depression of the dorsum, thinness of the border, angularity of the sides, flatness of the base, and prominence of the dorsal ambulacra, clearly distinguish *Pygurus costatus* from its other Oolitic congeners, and I am unacquainted with any other foreign form beside those enumerated with which to compare our urchin.

Locality and Stratigraphical position.—This species was collected from the Lower Calcareous Grit of Oxfordshire and Wiltshire; the specimen I have figured was found near Oxford, and I have another from the same rock near Calne. It is not a common species, as I have rarely seen it in collections of Calcareous Grit fossils. The specimen I have figured was most kindly given to me for this work by my friend, the Rev. P. B. Brodie.

PYGURUS BLUMENBACHII, *Koch* and *Dunker*. Pl. XXXVIII, figs. 1 and 2.

CLYPEASTER BLUMENBACHII.		Koch and Dunker, Norddeutschen Oolithgebildes, pl. iv, fig. *a*, *b*, *c*, p. 37, 1837.
PYGURUS BLUMENBACHII.		Agassiz and Desor, Catalog. raisonné des Échinides, Annales des Sciences Naturelles, 3e série, t. vii, p. 162, 1847.
—	—	D'Orbigny, Prodrome de Paléont. Stratigr., t. i, p. 26, étage 14e, 1850.
—	—	Wright, Ann. and Mag. of Nat. Hist., 2d series, vol. ix, p. 312, 1851.
—	—	Forbes, in Morris's Catalog. of Brit. Fossils, 2d ed., p. 88, 1854.
—	—	Cotteau, Études sur les Échinides Fossiles (Yonne), pls. xxxiii and xxxvi, p. 233, 1856.
—	—	Desor, Synopsis des Échinides Fossiles, p. 313, 1858.

Test thin, sub-quadrate, with a sinuous border; upper surface elevated anteriorly, gradually declining posteriorly; apical disc excentral forwards, forming the vertex; ambulacral areas and poriferous zones broadly petaloid on two thirds of the dorsal surface; anterior border emarginate and concave; sides crescentic; posterior border produced, rostrated, and much deflected; under surface concave, with prominent basal inter-ambulacra. Mouth-opening large, sub-central; peristome with five very prominent oral lobes, and five phylloid ambulacral floscules. Tubercles in general small, but larger on the anterior part and at the base.

Dimensions.—Height, one inch and a quarter; antero-posterior diameter, two inches and one fifth; transverse diameter, two inches and three tenths.

Description.—The Oolitic Pyguri, in general, have a remarkable similarity in their external form; so much so, that it frequently requires a careful examination of their characters to distinguish allied species from each other. It is, however, altogether different with *Pygurus Blumenbachii*, which forms a remarkable exception to the general rule. In this singular urchin the outline is sub-quadrate, the anterior border is emarginate and concave, and deeply indented by the central sulcus (fig. 1 *a*, fig. 2 *a*); the lateral parts of the margin are convex; the posterior border consists of a double sinuous line, in the centre of which is the single inter-ambulacrum, this forms a convex, rostrated prominence, slightly deflected downwards (fig. 1 *a*, fig. 2 *a*). The upper surface presents a most singular profile (fig. 1 *d*); the anterior half is relatively much elevated and turgid, and the posterior half slopes gently downwards to the border.

The dorsal ambulacra are broadly petaloid at the upper half and extremely narrow at the lower half, and their wide, lanceolate apices are closely approximated around the disc (fig. 1 *a*, fig. 2 *a*).

The poriferous zones consist of an inner row of round holes and an outer row of

oblique, slit-like apertures, which are limited to the upper half of the rows (fig. 2 *b*); in the lower half, the pores are simple, like those of the inner row; at the border, the holes are so minute they cannot be distinguished; at the base they are placed wide apart (fig. 1 *b*), and near the mouth the ambulacra expand into phylloid expansions, which, near the peristome, are contracted by large oral lobes.

The inter-ambulacral areas are very unequal in width and development; the anterior pair are narrow, convex, and prominent; they rise nearly perpendicular, forming with the base an angle of 80°, and near the vertex curve backwards; the plates on the inner sides of the areas, as well as on the single ambulacrum, carry much larger tubercles than the other dorsal plates (fig. 1 *a*, fig. 2 *a*); the posterior pair and the single area incline to an angle of about 35°. The upper surface thus acquires the remarkable anterior elevation which gives so marked a character to this species, and allies it with a Neocomian form—*Pygurus Montmollini*, Ag. The single inter-ambulacrum possesses a central elevated portion on its upper surface, made more apparent by two lateral depressions commencing at the inner zone of the postero-lateral ambulacra, which gradually rise and blend with the central elevation (fig. 1 *c*); this is continued downwards and backwards, and forms the rostrated portion of the single area, which is slightly deflected at its termination (fig. *c*, *d*).

The apical disc is small and excentral, and nearer the anterior border; it consists of four small, perforated, ovarial plates (fig. 3), a single smaller, imperforate plate, and five very small ocular plates, perforated near their centre; the spongy, madreporiform body rises from the surface of the right antero-lateral plate, extends into the centre of the disc covering the inner portions of the ovarial plates, and having the ocular plates disposed around its circumference.

The under surface is concave, and very much undulated, the ambulacra forming narrow, depressed valleys from the border to the mouth, and the basal inter-ambulacra extremely convex eminences between them (fig. 1 *b*, *c*); near the mouth-opening their terminal portions are developed into five tumid lobes.

The large sub-central mouth-opening is directly beneath the apical disc; it is consequently nearer the anterior than the posterior border; the peristome is surrounded by five oral lobes, which alternate with five phylloid ambulacra, filled with several longitudinal rows of pores (fig. 1 *b*).

The anal valley is a slight depression, formed out of a prominent portion of the basal inter-ambulacrum; it has declining sides, covered with large tubercles, and is quite infra-marginal; the vent is oval, and elongated in the antero-posterior diameter (fig. 1 *b*, fig. 1 *c*).

The tubercles on the dorsal surface are very small, and arranged in five concentric rows on each plate (fig. 2 *b*); they are encircled by sunken areolas, and the intermediate space is covered with close-set miliary granules (fig 2 *d*). On the antero-lateral inter-ambulacra and single ambulacrum the tubercles are considerably larger (fig. 1 *a*, fig. 2 *a*); at the

base they are still larger, and their deep areolas form hexagonal cells on different portions of the base.

Affinities and differences.—In its general characters, but more especially in the oblique, tumid, conoidal elevation of the anterior half of its upper surface, *Pygurus Blumenbachii*, Koch, resembles three other congeneric forms—*Pygurus Montmollini*, Ag., *P. Orbignianus*, Cott., and *P. Rogerianus*, Cott., from each of which it is distinguished, however, by specific characters; the first and second are Neocomian, and the latter Kimmeridge species. It differs, according to M. Cotteau, from *Pygurus Montmollini*, Ag., in its greater size, less elevated upper surface, and more rostrated posterior border. It differs from *Pygurus Orbignianus*, Cott.,* equally by its size, by its less conical upper surface and more tumid anterior border, by its petalloid ambulacra being more slender, by its inter-ambulacral tubercles being closer together and more irregularly disposed. *Pygurus Rogerianus*, Cott.,† more closely resembles *P. Blumenbachii*, but it appears to M. Cotteau, who has carefully compared these two species, that *P. Rogerianus* is distinguished from the latter by the test being much longer than it is wide, by the upper surface being more depressed, its tubercles being less numerous, and its intermediate granules disposed in regular and concentric series.‡

The only two English specimens of this urchin which I know are those figured in our plate; the largest belongs to the Museum of Practical Geology, and was collected by the officers of the Geological Survey; the other is in my cabinet. These Pyguri are much smaller than the very fine specimens which my friend M. Cotteau has so well figured and described in his work, hence the comparison which he has made was between these fine large specimens and the other species above enumerated, and which all belong to the secondary rocks of France. M. Cotteau's specimen measures in height 34 millimètres = one inch and nine twentieths; antero-posterior diameter, 87 millimètres = nearly three inches and a half; and transverse diameter, 86 millimètres = three inches and four tenths.

Locality and Stratigraphical position.—The specimen collected by the officers of the Geological Survey was obtained from the Coral Rag at Abbotsbury, Dorsetshire, where it is extremely rare. My specimen was said to have been procured from the Inferior Oolite, near Yeovil, but this I have discovered to be a mistake. I have reason to believe that it was collected from the Lower Calcareous Grit at Bullington Green, near Oxford, associated with *Cidaris Smithii*, Wr., and *Echinobrissus scutatus*, Lamk.

The foreign distribution of this species is as follows: In France it characterises the inferior and superior stages of the Corallien. M. Cotteau collected it in "Calcaire blancs

* 'Catalogue raisonné des Échinides du Terrain Néocomien,' p. 12.

† "Note sur les Échinides de l'étage Kimmeridgien de l'Aube," 'Bull., de Géol. Soc. de France,' 2e série, t. xi, p. 356.

‡ 'Études sur les Échinides Fossiles du departement de l'Yonne,' p. 238.

et Pisolitique" of Châtel-Censoir, and of Coulanges-sur-Yonne, where it is very rare; it is found more frequently in the "Couches Coralliennes supérieures" of Baily, of Thury, and of Tonnerre; the specimens collected from the latter locality by M. Rathier were in fine preservation, and were nearly as large as those found at Thury.

This species has likewise been found by MM. Cotteau and Royer in the "Calcaires à Astartes de l'Aube et de la Haute-Marnes."

The original German specimen was found, according to Koch and Dunker, in the "krystallinischen Dolomitquadern des oberen Korallenkalkes am Waltersberge bei Eschershausen."*

Professor Roemer kindly sent me a specimen of *Pygurus Blumanbachii*, Koch, which was collected from the so-called Portland-Kalk, *zone of Pterocera Oceani*, at Hildesheim, Hanover. This rock Dr. Oppel † considers to be the equivalent of our Kimmeridge clay, and not of the true Portland stage. The occurrence of this urchin in the zone of *Pterocera Oceani* strengthens my learned friend's opinion, as MM. Cotteau and Rathier have already found it in the "Calcaires à Astartes," in l'Aube, and Haute-Marne, which is the true equivalent of the Astartekalke of Lindener Berg, and of the environs of Hildesheim.

PYGURUS PHILLIPSII, *Wright*, nov. sp. Pl. XXXIX, fig. 1, *a*, *b*, *c*, *d*.

PYGURUS PHILLIPSII. Wright, Report on British Oolitic Echinodermata, British Association Reports, p. 402, vol. for 1856.

Test nearly orbicular, rather longer antero-posteriorly than transversely; rounded before, slightly produced behind; upper surface very much depressed; sides rounded; anal valley very near the border; ambulacral areas narrow; poriferous zones petaloid on five sixths of the dorsal surface; apical disc small, nearly central, four rows of tubercles on the large plates; inter-ambulacra with slight central triangular elevations, which occasion corresponding tumidities at the border; anal valley wide and deep, causing an emargination of the posterior border.

Dimensions.—Height, one inch; antero-posterior diameter, nearly four inches; transverse diameter, three inches and three quarters.

* Norddeutsch. Oolithgebildes, p. 38.

† Die Juraformation, p. 763.

Description.—The beautiful specimen figured in Pl. XXXIX is the only one of this form I have seen. The upper surface, sides, and outer part of the base, are in fine preservation, but the greater portion of the under side is concealed by the matrix.

The test is thin, and has a sub-orbicular circumference; it is rounded before, and slightly produced behind, the difference between the length and width being only one quarter of an inch.

The dorsal ambulacra are narrow, only slightly expanded in their upper half, and terminating in sharp, lanceolate apices around the disc (fig. 1 *a*); they have six rows of tubercles, disposed alternately on the plates, so that they form double oblique rows, with three tubercles in each (fig. 1 *d*).

The poriferous zones, of moderate width, are petalloid five sixths of the distance between the border and disc; as in all other Pyguri, the holes of the inner row are nearly round, those of the outer row are oblique or nearly transverse slits, which about equal in length the width of one half of the area (fig. 1 *c*); between each slit-like aperture there is a partition of the test, on the surface of which a series of ten granules are very regularly arranged (fig. 1 *d*) in a single row; at the borders the pores lie close together, in single pairs, but they are wider asunder at the base.

The inter-ambulacral areas are of unequal width; the anterior pair are about one sixth narrower than the posterior pair; they are formed of long, narrow plates, which are bent to an obtuse angle in the middle; along the line of these angles the surface of the test is slightly elevated, producing in the middle of each area a triangular elevation, the base of which is at the border, and the apex towards the disc (fig. 1 *a*); the margin, in like manner, exhibits a fulness corresponding with the bases of these elevations.

The apical disc is absent, and the space for its reception is small in comparison with the size of the test.

The tubercles are beautifully preserved in this species (fig. 1, *c*, *d*); on the upper surface each plate carries four horizontal rows, which are arranged in zigzag order above one another; the tubercles are all perforated, and crenulated, and raised on small mammillary eminences; the areolas which encircle them are wide and well defined; a circle of miliary granules surrounds the areolas, and other granules fill up all the intermediate spaces; the granules are surrounded by narrow areolas, which impart a highly sculptured character to the surface of the test.

The anal valley lies so near the posterior border that it produces an emargination thereof (fig. 1 *a*); when viewed from behind, the vent is seen quite in the border of the rostrated portion of the single inter-ambulacrum (fig. 1 *b*).

The tubercles at the border and base are much larger and more prominent than those on the upper surface; and the areolas present a regular hexagonal disposition around the margin and at the base.

I have only seen one specimen of this urchin, embedded on a portion of Coralline Oolite limestone; the test is very thin, and has been fractured, the joint having been

closed again by crystallization in the rock; the base is nearly entirely concealed by adhering matrix.

Affinities and differences.—The flatness of the upper surface and the form of the ambulacral areas in this species closely resemble *Pygurus Hausmanni,* but the test is narrower before, wider near the middle, and more rostrated posteriorly, than the usual specimens of that large species. I have, therefore, described it under a distinct name, not, however, without misgivings of its propriety, as a series of specimens might exhibit intermediate links, by which the two forms would blend into one type. This is one of the many difficulties to be encountered in describing new species from single examples, which in the present instance is unavoidable; time and additional specimens, however, will prove how far my doubts are well-founded or otherwise.

Locality and Stratigraphical position.—This species was collected from the Coralline Oolite at Malton, Yorkshire, where it is extremely rare; the specimen I have figured is the only one I have seen.

History.—This urchin was first recorded in my memoir 'On the Stratigraphical Distribution of the Oolitic Echinodermata,' afterwards published as one of the 'Reports of the British Association for the Advancement of Science,' for the year 1856. It is now figured for the first time, and dedicated to my learned friend, Professor John Phillips, of Oxford.

PYGURUS HAUSMANNI, *Koch* and *Dunker.* Pl. XL; Pl. XXX, fig. 2.

CLYPEASTER HAUSMANNI.	Koch and Dunker, Versteinerungen des Ool. Gebirg., tab. iv, fig. 3, p. 38, 1837.
— —	Leymerie, Stat. Géol. et Min. du dép. de l'Aube, p. 239, 1846.
PYGURUS HAUSMANNI.	Agassiz et Desor, Cat. raisonné des Échinides, An. des Sciences Naturelles, 3e serie, tom. vii, p. 162, 1847.
— —	D'Orbigny, Prodrome de Paléontologie, tom. ii, p. 26, 14e étage, 1850.
— —	Cotteau, Note sur les Échid. de l'étage Kimmeridg., Bull. Géol. Soc. de France, 2e serie, tom. xi, p. 317, 1853.
— —	Forbes, in Morris's Catalogue of British Fossils, 2d ed., p. 83, 1854.
— —	D'Orbigny, Paléontologie Française Ter. Cretacés, t. vi, p. 301, 1856.
— —	Cotteau, Études sur les Échinides Fossiles, p. 328, 1856.
— —	Desor, Synopsis des Échinides Fossiles, p. 314, 1858.
— GIGANTEUS.	Wright, Oolitic Echinodermata, Report of the British Association for the Advancement of Science for 1856, p. 396.

Test large, sub-circular, sometimes oval, and slightly rostrated posteriorly; upper surface flattened, and much depressed; base sub-concave, rounded anteriorly, and slightly produced posteriorly; ambulacral areas on the upper surface nearly equal-sized and lanceolate; poriferous zones petalloid near to the border; apical disc small, nearly central; inter-ambulacral areas broad and flat, with a very distinct zigzag median suture; margin very thin; base sub-concave; mouth-opening small, situated nearer the anterior than the posterior border.

Dimensions.—A. Antero-posterior diameter, six inches and four tenths; transverse diameter, six inches; height indeterminable.

B. Antero-posterior diameter, five inches and one fourth; transverse diameter, four inches and nine tenths; height, one inch and three tenths.

Description.—This large discoidal urchin is remarkable for the great size it attains; nearly all the specimens I have seen are broken, and more or less imperfect, so that the identification of the species is extremely difficult. Last summer, however, I met with one which had retained the form of its circumference, as well as the shape of its upper surface, and this example enabled me to identify the species I had formerly named *Pygurus giganteus* with Koch and Dunker's *Clypeaster Hausmanni*. It is, therefore, extremely interesting to find this urchin in the same horizon of the Coralline Oolite of Malton, the zone of *Cidaris Blumenbachii*, the one it occupies in the Korallenkalk of northern Germany.

Pygurus Hausmanni has in general a sub-circular outline, rather inclining to an oval, its transverse diameter being always less than its antero-posterior measurement; the anterior border is rounded, and in specimen B the posterior border is a little produced; the upper surface is moderately convex in the smaller specimen, but is very much flattened in the larger ones, and the anterior half is more convex than the posterior half.

The ambulacral areas are narrow and lanceolate; they have six rows of small tubercles in their widest part, which are not all arranged in a horizontal series on the two corresponding plates of the area, but are disposed thereon so as to form oblique V-shaped rows. Plate XXXIX, fig. 2, exhibits this arrangement of the tubercles. The poriferous zones are moderately wide, the holes of the inner row are round, those of the outer row are slit-like, of which there are eight pairs opposite each large plate (fig. 2); the septum between each pair of holes supports on its upper surface a horizontal row of nine small granules. The ambulacral areas and poriferous zones form together a series of five elegant leaf-shaped petals, which are enlarged in the middle, become lanceolate near the disc, and are contracted at the circumference; the poriferous zones are petaloidal six sevenths of their length; and near the lower seventh the pores approximate; in their course round the margin, and across the base they remain close together in pairs.

The inter-ambulacral areas are of unequal width, the anterior pair are the narrowest, and the posterior pair and single area are the widest; the former in B measures two inches and four tenths, and the latter, which are about the same width, measure two inches and nine tenths across. The long plates forming these areas are bent in the middle (Pl. XL), and their surface is covered with four rows of small, regularly arranged, crenulated and perforated tubercles, raised on bosses, and surrounded by sunken areolas; the inter-tubercular portion of the plates is covered with close-set miliary granules. (Pl. XXXIX, fig. 2.)

The small apical disc is situated at the vertex, rather nearer the anterior than the posterior border; the discal elements are soldered together, and nothing but the four ovarial holes, and small central madreporiform body are visible in the specimens I have hitherto seen.

In all the specimens of this urchin I have examined in different collections, the under surface is covered with the Oolitic matrix, which adheres so firmly that it is impossible to remove it; the structure of the base is therefore unknown to me. M. Cotteau, however, states, "That at the inferior surface, in his specimen, the ambulacra converge in a straight line to the mouth; they are narrow, bordered with pores, set wide apart, and enclosed in very apparent depressions, which alternate with the elevations of the inter-ambulacral areas."

The anal opening is situated just below the posterior border, it has an oval form, its long diameter corresponding to the antero-posterior diameter of the test.

The mouth-opening, according to M. Cotteau, is excentral, nearer the anterior border, the peristome is pentagonal, and surrounded with five prominent oral lobes.

The test of this species is very thin and delicate, a circumstance which may account for the fractured condition in which it is so often found; in general it is met with in masses of Oolitic limestone, from which it has to be cut out with great care.

Affinities and differences.—This gigantic urchin so much resembles *Pygurus Phillipsii*, Wr., in all the leading points of its structure, that it is possible the latter may be only a young form of *Pygurus Hausmanni*; it requires, however, more specimens than I have hitherto had at my disposal to state this as a fact. *Pygurus Hausmanni* in its magnitude resembles *Pygurus Icaunensis*, Cotteau, but it differs from the latter in having its upper surface more depressed, its ambulacral areas narrower, and in preserving their petaloidal figure near to the border, whilst in *P. Icaunensis* they are wider in the upper half, and much narrower in the lower half; the base of this urchin is likewise more concave and the inter-ambulacra more prominent and cushioned. *P. Hausmanni* differs from *Pygurus pentagonalis* in having the dorsal surface more depressed, the general outline more sub-circular, the ambulacral areas narrower above and wider below, and the single inter-ambulacrum less rostrated than in the latter species. The prominence and elevation of the ambulacra in *Pygurus costatus* with its pentagonal form readily distinguish it from

Pygurus Hausmanni, although the great depression of the test in both these species produces a close resemblance between them.

Locality and Stratigraphical position.—This large species has hitherto been found in England, only in the Coralline Oolite, at Malton, Yorkshire, and always in the thick bedded limestones of that formation, associated with *Clypeus subulatus, Cidaris florigemma, Echinobrissus dimidiatus* and *Collyrites bicordata.*

In France it has been collected, according to M. Cotteau, in the "Calcaires à Astartes de l'Aube," at the environs of Longchamps, by M. Royer, and at Polisot by M. Leymerie; M. d'Orbigny states that it is found in the "étage corallien" of Tonnerre, and Thury, (Yonne).

In Germany it was collected by Koch and Dunker* in the "Oberen Korallenkalk," at Kleinenbremen, near Bückeburg, associated with *Astrea*? *helianthoides*, Goldf., *A. agaricites*, Goldf., *Terebratula lacunosa*, Schl., and *Cidaris Blumenbachii*, Münst.

History.—This large urchin was described and figured in 1837 for the first time by Koch and Dunker; it has been subsequently described by M. Cotteau, and mentioned in the different works enumerated in the synonyms of this species.

* Beiträge des Norddeutch Oolithgebirg, p. 38.

NOTES

On Foreign Jurassic species of the genus PYGURUS, nearly allied to British forms, but which have not yet been found in the English Oolites.

Pygurus acutus, *Agassiz.* Catalogue raisonné des Échinides, p. 104.

Test elongated, and depressed, sensibly enlarged before and behind, its form resembling *Pygurus productus* from the Neocomian, posterior border rostrated, vent oblong, and infra-marginal.

Formation.—Inferior Oolite of Nantua.

Collection.—M. d'Orbigny.

Pygurus depressus, *Agassiz.* Syn. *Pygurus depressus,* Cotteau and Triger. Échinides du départ. de la Sarthe, pl. xx, fig. 1—6; p. 90.

Test sub-orbicular, or elongated, slightly depressed before, and much rostrated behind; upper surface elevated and uniformly convex, inferior surface depressed; deeply concave in the middle, and having the basal inter-ambulacra much cushioned; discal summit nearly central; ambulacral areas widely petaloid; poriferous zones very large, contracted at the lower fourth of the dorsal surface, apical disc small, slightly prominent and excentrally forwards; vent elongated, opening near the posterior border in a deep depression; mouth-opening, excentral, nearer the anterior border; peristome pentagonal, surrounded by five oral lobes, with which five ambulacral petals alternate.

Dimensions.—Height eight tenths of an inch; antero-posterior diameter, one inch and four tenths; transverse diameter, two inches and one quarter.

Formation.—Kelloway ferrugineux, Ass. No. 2, M. Triger; Chauffour, Sarthe.

Collections.—MM. Triger, Cotteau, one specimen in my cabinet collected by M. Sœmann, at Chauffour, Sarthe, and kindly sent me for this work.

PYGURUS (ECHINANTHUS) ORBICULATUS, *Leske.* Syn. *Pygurus orbiculatus,* Cotteau and Triger, Échinides du la départ. de la Sarthe, pl. xix, fig. 6—7, p. 88.

Test large, sub-circular, longer in length than in width; upper surface a little elevated, sub-conical, and depressed at the border; base almost flat; basal inter-ambulacra not prominent; summit slightly excentrally forwards; ambulacral areas lanceolate; poriferous zones very wide, and petaloidal almost to the margin; apical disc small, slightly excentral; vent oval, infra-marginal, situated in a deep depression. Mouth opening small, sub-central nearer the anterior border; peristome pentagonal, surrounded by five small oral lobes, with which five wide ambulacral petals alternate.

Dimensions.—Height, nine tenths of an inch; antero-posterior diameter three inches; transverse diameter, two inches and eight tenths.

Formation.—Kelloway ferrugineux, Ass., No. 2, M. Triger, Coulans, Chauffour, Montbizot, environs of Mamers, Sarthe.

Collections.—MM. Michelin, Triger, Guéranger.

PYGURUS MARMONTI, *Beaudouin.* Syn. *Pygurus Marmonti,* Desor, Synopsis des Échinides Fossiles (p. 316).

Test large, sub-circular, much depressed on the upper surface; ambulacral areas lanceolate; poriferous zones wide, petaloidal to the margin; base flat; inter-ambulacral basal cushions distinctly flattened on the surface; mouth-opening small, pentagonal, and sub-central; peristome surrounded by five oral lobes, which alternate with five ambulacral petals; vent small, oval, situated in a deep depression removed a short distance from the border. M. Cotteau suggests that it might be necessary to unite this species with *P. orbiculatus,* from which it differs in having a more circular form, and likewise in the vent being removed a little farther inwards from the border; it is found in the same zone with that urchin, and may be only a variety of it.

Dimensions.—Height, nine tenths of an inch; antero-posterior diameter three inches and one quarter; transverse diameter, three inches.

Formation.—"Kellovien de Chatillon sur Seine, Mamers Estrochey (Côte d'Or), Grande Oolite de Normandie." Desor.

One of the two specimens in my cabinet was collected by M. de Loriere from the "Étage Kellovien Chauffour, Sarthe." The other was obtained from the Kelloway ferrugineux Estrochey (Côte d'Or).

Collections.—MM. Michelin, Deslongchamps, Cotteau, my cabinet.

PYGURUS ICAUNENSIS, *Cotteau.* Études sur les Échinides Foss., pl. xxxvii, xxxviii.

Test large, sub-circular, length and breadth nearly equal; upper surface elevated and conoidal; under surface concave; ambulacral areas petaloid, very narrow below, dilated in the middle, and lanceolate above; poriferous zones wide, and petaloidal two thirds the distance between the disc and border; base deeply concave; basal inter-ambulacral areas very convex and prominent; mouth-opening excentral, small, pentagonal, nearer the anterior border, surrounded by five oral lobes, and five wide ambulacral petals; anal opening large, oval, infra-marginal, situate in a deep depression. This large species resembles *P. Hausmanni*, of which M. Desor suggests it may probably be a variety; the plaster mould in my collection exhibits very decided specific differences between it and the discoidal urchin I have identified with the German species.

Dimensions.—Height, one inch and a quarter; antero-posterior diameter four inches and a half; transverse diameter, four inches and three tenths.

Formation.—Calcaréo-siliceous strata of the Inferior Coralline Oolite at Druyes, (Yonne). Rare.

Collections.—M. Cotteau; only two specimens known. A plaster mould of the figured specimen in my collection.

PYGURUS TENUIS, *Desor.* Synopsis des Échinides Fossiles, p. 315.

"Test large, circular, much dilated; border thin, almost trenchant; summit central; ambulacral petals very long, petaloidal almost to the margin." Desor.

Formation.—"Portlandien inférieur (Astartien) d'Oberbuchsitten (Canton de Soleure), Oolite Astartienne de Laufon (Jura Soleurois), Delémont." Desor.

Collections.—Mus. de Neuchâtel; M. Michelin.

PYGURUS JURENSIS, *Marcou.* Mem. Soc. Geol. de France, 2de serie, tom. iii, p. 114.

"Test dilated, and rostrated; summit excentral; ambulacral areas large, extending petaloidal almost to the border; under surface much undulated; anal opening inframarginal." Desor.

Formation.—" Portlandien supérieur (Virgulien) de Suziau près Salins, des environs de Morteau, Gray, Haute-Saône.
Portlandien moyen (Ptérocérien moyen) de Montbéliard." Desor.

Collections.—MM. Marcou, Thurmann, Jaccard, d'Orbigny.

ON

THE STRATIGRAPHICAL DISTRIBUTION

OF THE

OOLITIC ECHINODERMATA.*

All the classes of the animal kingdom, when viewed in relation to their stratigraphical distribution, are not of the same value to the palæontologist. Some Mollusca, as the Conchifera and Gasteropoda, have a much greater extension in time than the Cephalopoda, and among Radiata, the Echinodermata and Anthozoa may be adduced as examples of classes whose life was alike limited; in estimating the value of palæontological evidence, therefore, it is necessary to take into consideration this important fact, which has not received the attention it is so justly entitled to.

The Echinodermata, although occupying a low position in the animal series, in a zoological point of view, still afford the palæontologist most important data for discussing questions relative to the distribution of species in time and space; it is well known, for example, that the Silurian, Devonian, and Carboniferous rocks are all characterised by distinct forms of Crinoidea, most of which are limited in their range to the different stages of these great groups. It is the object of this chapter, however, to show that the species of Oolitic Echinodermata had a like limited range in time, and that the different stages of the Oolitic formations are characterised by species which are special to each.

Dr. William Smith was doubtless aware of the value of the Echinodermata in stratigraphical geology, for he carefully noted the different species known to him which characterised the different subdivisions of the secondary rocks; and it is a remarkable fact, in connection with this subject, that although our knowledge of the species of this class

* The stratigraphical distribution of the Echinodermata, originally written for this work, was communicated, in the form of a memoir, to the Geological Section of the British Association, at the meeting held at Cheltenham, in August, 1856. The Council did me the honour, to order the communication to be printed entire among their Reports; for this reason it appeared in the 'Report of the British Association for the Advancement of Science for 1856,' and is now corrected down to the present date.

as been nearly quadrupled since the publication of his works,* still the outlines sketched y the hand of our great master remain nearly the same as laid out by him.

I have already shown that the test of the Echinodermata constitutes an internal and tegral part of the body of the animal, participating in its life, intimately connected with ie organs of digestion, respiration, and generation, as well as with those of vision and comotion, and consequently having many of the distinctive characters of the organism delibly impressed on different parts of the skeleton. The individual plates composing e columns of the test of the ECHINOIDEA, and the ossicula forming the skeletons of the STEROIDEA, OPHIUROIDEA, and CRINOIDEA, are organized after distinct plans; they are erefore of great value in determining the species, as the specific characters are often ell preserved on even fragmentary portions of the skeleton; for this reason the remains these animals are of the highest value in stratigraphical geology, and second in nportance to no other class of the animal kingdom.

In the ECHINOIDEA the body is spheroidal, oval, depressed or discoidal, and enclosed a calcareous test or shell composed of ten columns of large plates constituting the *ter-ambulacral* areas; and ten columns of small plates constituting the *ambulacral areas*, nich segments are separated from each other by ten rows of holes constituting the *riferous zones*. The external surface of the plates is studded with tubercles of different es, in the different families; to these the spines are articulated, by a kind of ball-and-cket joint, which are of different sizes, forms, and dimensions in the different families, d serve to characterise the genera and species.

At the summit of the test is the apical disc, composed of five genital plates perforated the passage of the ovarial and seminal canals; and five ocular plates notched or per-rated for lodging the eyes: in one family, the SALENIADÆ, an additional or suranal ate, composed of one or many pieces, is introduced within the circle formed by the nital and ocular plates.

There are two great apertures in the shell, one for the mouth, which is always at the se; the other for the anus, which occupies different positions on the test; in one section is in the centre of the upper surface, directly opposite to the mouth, and surrounded by e genital and ocular plates; in a second section the vent is external to the circle of nital plates, and never opposite to the mouth, but situated in different positions in ation to that opening, being placed on the upper surface, on the sides, the border, the ra-border, or the base, in the different groups.

The mouth is often armed with a complicated apparatus of jaws and teeth, it is sometimes edentulous, and provided with lobes formed of the plates of the test elf.

The ASTEROIDEA have a depressed stelliform body provided with five or more lobes or low arms, which are a continuation of the body, and contain prolongations of the

* 'Strata identified by Organized Fossils,' 4to, 1816.—'Stratigraphical System of Organized Fossils,' 1817.

viscera. The mouth is always below and central; two or four rows of tubular retractile suckers occupy the centre of the rays; and in two families an anal vent opens at the central or sub-central part of the dorsal surface. The complicated skeleton is composed of numerous solid calcareous ossicula, variable as to number, size, and arrangement in the different genera which they serve to characterise. Their coriaceous integument is often studded with pedicellariæ and calcareous spines of various forms; they have a spongy madreporiform body situated on the upper surface of the disc near the angle between two rays; and reptation is accomplished by retractile tubular ambulacral suckers.

The Ophiuroidea have a distinct depressed discoidal body surrounded by long slender rays, in which there is no excavation for any prolongation of the viscera; they are special organs of locomotion, independent of the visceral cavity, and provided with spines which are supported on their sides; they have no pedicellariæ; the mouth is basal and central, surrounded by membranous tentacula, and they have no anal vent. The skeleton is composed of a series of plates which form the disc or centrum, and the long slender rays are sustained by numerous elongated vertebra-like ossicula, having numerous plates or spines disposed along the borders of the rays to assist in reptation. The form, structure, arrangement, and covering of the discal plates, and of the ossicles of the rays, afford good characters for distinguishing the genera.

The Crinoidea have a distinct bursiform body formed of a calyx, composed of a definite number of plates, provided with five solid rays, independent of the visceral cavity, and adapted for prehension; they have a distinct mouth and vent, no retractile suckers, and the ovaries open into special apertures at the base of the arms. The skeleton is extremely complicated, being composed in some genera of many thousands of ossicula articulated together, the number, form, and arrangement of which are determinate in the different families, the multiples of five being the numbers which in general predominate; the central plate of the calyx is supported on a long jointed column composed of circular, pentagonal or stelliform plates, the articulating surfaces are sculptured with crenulations which interlock into each other; in many genera the stem was attached by a calcareous root to the bed of the sea, and supported the calyx and arms upwards like a plant; in others it appears to have been moveable, and was used as a point of suspension from submarine bodies, the calyx and arms having had a pendent position.

The mouth is central and prominent, and the vent opens near its side; the arms are mostly ramose and multiarticulate, and when extended form a net-like instrument of considerable dimensions.

The four orders of Echinodermata thus briefly described are the only ones found fossil in the oolitic rocks, and of these by far the largest number of species belong to the Echinoidea; for this order I have proposed the following classification, which differs in many essential particulars from that of previous authors.

As the mouth is always basal, central, subcentral, or excentral, the excentricity being invariably towards the anterior border, this aperture does not afford a character of primary

importance, although when taken in connexion with others it is valuable in the definition of families.

The position of the anal opening affords a good primary character; in one section the vent opens *within* the centre of the apical disc, surrounded by the genital and ocular plates; in another section the vent opens *without* the apical disc, and is external to, and at a greater or less distance from, the genital and ocular plates; these two sections may be thus defined.

ECHINOIDEA ENDOCYCLICA.

A. Test circular, spheroidal, more or less depressed, rarely oblong; mouth central and basal; vent in the centre of the upper surface directly opposite the mouth, and surrounded by five perforated genital and five ocular plates. Mouth always armed with five powerful calcareous jaws, formed of many elements disposed in a vertical direction.

ECHINOIDEA EXOCYCLICA.

B. Test sometimes circular and hemispherical, oftener oblong, pentagonal, depressed, clypeiform or discoidal; mouth central or excentral; vent external to the circle of genital and ocular plates, never opposite the mouth, situated in different positions in relation to that opening: four of the genital plates are generally perforated; the fifth is in general imperforate. Mouth sometimes armed with jaws, but oftener edentulous. Jaws disposed in a more or less horizontal direction.

The structure of the ambulacral areas and poriferous zones, the form, number, and arrangement of the tubercles and their spines, the presence or absence of fascioles or semitæ, the size and form of the elements of the apical disc, and the position of the anus, afford collectively good characters for defining the genera.

The minute details in the structure of the plates; the size, form, and number of the tubercles on each; the form and arrangement of the pores in the zones; their proximity or remoteness from each other; the general outline of the body, which has only certain limits of variation; the character of the sculpture on the plates; the form of the areolas; the greater or less prominence of the base; the size of the tubercles; the presence or absence, the size and arrangement of the granules forming the areolar circle; the completeness or incompleteness of the same; the width of the miliary zone, the number and size of the rows of granules composing it; the length of the spines; the form of their stems; the character of the sculpture thereon; the size of the head, the prominence and

milling of the ring,—are all details of structure which individually and collectively afford good specific characters, as they are persistent details which are more or less developed on every considerable fragment of the test and spines of Echinoidea.

Taking these characters for our guidance, I have grouped the genera, already so numerous by the discovery of extinct forms, into the following natural families:

A TABLE, SHOWING THE SECTIONS AND FAMILIES OF THE ECHINOIDEA.

ORDER.	SECTIONS.	FAMILIES.
Order—ECHINOIDEA	Section A. *Echinoidea endocyclica.* Vent within the genital plates, always opposite the mouth.	Cidaridæ.
		Hemicidaridæ.
		Diademadæ.
		Echinidæ.
		Saleniadæ.
	Section B. *Echinoidea exocyclica.* Vent without the genital plates, never opposite the mouth.	Echinoconidæ.
		Collyritidæ.
		Echinonidæ.
		Echinanthidæ.
		Echinolampidæ.
		Clypeasteridæ.
		Echinocoridæ.
		Spatangidæ.

A Table showing the Stratigraphical distribution of

FAMILIES, GENERA, AND SPECIES.	LOWER DIVISION.									
	LIAS.			INFERIOR OOLITE.			GREAT OOLITE.			
	Lower Lias.	Middle Lias.	Upper Lias.	Murchisonæ zone.	Humphriesianus zone.	Parkinsoni zone.	Fuller's Earth.	Stonesfield Slate.	Great Oolite.	Bradford Clay.
Fam. CIDARIDÆ.										
Cidaris Edwardsii, *Wright*	*	*								
Ilminsterensis, *Wright*	..	..	*							
Mooreii, *Wright*	...	...	*							
Fowleri, *Wright*	...	..	...	*						
Bouchardii, *Wright*	...	...	.	*	...	*				
Wrightii, *Desor*	.	...	...	*						
confluens, *Forbes*	...	...	..	.	...	*				
Bradfordensis, *Wright*	..	...	.	.	...	.	..	.	...	*
florigemma, *Phillips*	...	...	...		.	.	..	...	...	...
Smithii, *Wright*	..	...	..	..	...	.	..	...	..	...
spinosa, *Agassiz*	...	...	..	..	...	...	...	...	...	..
Boloniensis, *Wright*	...	...	..	.	...	...	...	...	...	..
Rabdocidaris Moraldina, *Cotteau*	...	*	. .	...	...	...	.	..	...	.
maxima, *Münster*	...	..	..	...	*	...	...	...	..	.
Diplocidaris Desori, *Wright*	...	...	..	*						
Wrightii, *Desor*	...	...	...	*						
Cotteauana, *Wright*	...	...	...	...	•					
Fam. HEMICIDARIDÆ.										
Hemicidaris granulosa, *Wright*	...	...	...	..	...	*	...	..	..	..
pustulosa, *Agassiz*	...	...	...	...	...	*	...	...	...	..
Stokesii, *Wright*	...	...	...	...	...	...	...	*		
Luciensis, *d'Orbigny*	...	..	...	..	...	.	..	...	*	..
minor, *Agassiz*	...	...	...	...	...	..	...	...	*	...
Ramsayii, *Wright*	...	...	...	...	...	...	...	..	*	

the genera and species of the Oolitic Echinodermata.

		MIDDLE DIVISION.					UPPER DIVISION.				Observations and Foreign Localities.
Forest Marble.	Cornbrash.	Kelloway Rock.	Oxford Clay.	Lower Calc. Grit.	Coralline Oolite.	Upper Calc. Grit.	Kimmeridge Clay.	Portland Sand.	Portland Oolite.	Purbeck Beds.	
...	...	...	..	*	*		.	..	...	.	France, Germany, and Switzerland.
...	.	.	.	*	*						
.		...	.	...	...		*		.		Switzerland.
...		. .	...	..	..		*				Boulogne-sur-Mer.
.	.	..	..	..	...	.	.		.		France.
..	...	..	.	..	...	...	.	.		..	Germany.
...	...	...	...	...	...	...	...	...	...	...	Ranville, France.
...	...	...	...	...	...	...	...	...	...	..	Ranville, France.
...	..	...	...	...	...	...	...	...	...	...	Luc, France.
...	..	...	...	...	...	...	...	...	...	...	Ranville, France.

FAMILIES, GENERA, AND SPECIES.	LOWER DIVISION.									
	LIAS.			INFERIOR OOLITE.			GREAT OOLITE.			
	Lower Lias.	Middle Lias.	Upper Lias.	Murchisonæ zone.	Humphriesianus zone.	Parkinsoni zone.	Fuller's Earth.	Stonesfield Slate.	Great Oolite.	Bradford Clay.
Hemicidaris Bravenderi, *Wright*	...	...	...	...	...	...	...	..	*	
Wrightii, *Desor*	...	...	..	.	.		..	..	..	*
Icaunensis, *Cotteau*	...	...	..	...	..	..	...	.	*	
intermedia, *Fleming*	..	..	..	...	.	.	.		.	
Davidsonii, *Wright*	..	..	...	...	.	.		..	.	
Purbeckensis, *Forbes*	...	..	...	...	..	..		...		
Fam. DIADEMADÆ.										
Pseudodiadema lobata, *Wright*	*									
Mooreii, *Wright*	...	...	*							
Wickense, *Wright*	...	...	*							
depressum, *Agassiz*	...	...	...	*	*			.	.	
Parkinsoni, *Desor*	...	...	...	...	...	...	...	*		
pentagonum, *M'Coy*	...	..	...		.				*	
homostigma, *Agassiz*	.	...	...	.	.	.	.	.		.
Bailyi, *Wright*	...	...	...	...	...	...	...			
vagans, *Phillips*	..	...	...						*	
Bakeriæ, *Woodward*	.	...	...			.				
versipora, *Phillips*	.	...								
hemisphæricum, *Agassiz*	..	...				.	..			
radiatum, *Wright*	..	...		..		.	..			
mamillanum, *Roemer*	...	..	.	.			..			...
Hemipedina Bechei, *Broderip*	*									
Bowerbankii, *Wright*	*									
Tomesii, *Wright*	*									
Jardinii, *Wright*	...	*								
Etheridgii, *Wright*	...	...	*							

MIDDLE DIVISION.							UPPER DIVISION.				Observations and Foreign Localities.
Forest Marble.	Cornbrash.	Kelloway Rock.	Oxford Clay.	Lower Calc. Grit.	Coralline Oolite.	Upper Calc. Grit.	Kimmeridge Clay.	Portland Sand.	Portland Oolite.	Purbeck Beds.	
...	...	.	..		.	...	..	..	...	..	France.
..	.	..	..	.	*	...	...	...	...	...	France and Germany.
.	..	.		.	.	..	.	*	...	...	Boulogne-sur-Mer.
...		..		..	.	..	...	...	...	*	France.
..	..				...	...	...	...	...	...	France.
...	*	...	...	...	...	...	...	...	...	...	France and Switzerland.
.	*										
...	*	...	...	...	...	...	...	...	...	...	Switzerland.
.	*										
.	.	.	..	..	*						
...	..	...	.	..	*	...	...	...	...	...	France and Switzerland.
...	.	.	..	...	*						
...	.	.	...	...	*	...	..	...	...	...	France and Germany.

FAMILIES GENERA, AND SPECIES.	LOWER DIVISION.									
	LIAS.			INFERIOR OOLITE.			GREAT OOLITE.			
	Lower Lias.	Middle Lias.	Upper Lias.	Murchisonæ zone.	Humphriesianus zone.	Parkinsoni zone.	Fuller's Earth.	Stonesfield Slate.	Great Oolite.	Bradford Clay.
Hemipedina Bakeriæ, *Wright*	..	..	..	*	.	..	.	...	...	
perforata, *Wright*	.	..	...	*						
tetragramma, *Wright*	..	..	...	*						
Waterhousei, *Wright*	.	...	.	*						
Bonei, *Wright*	..	..	..	*						
Davidsoni, *Wright*	..	.	.	.	.	.			*	
Woodwardii, *Wright*	...	...	...	...	...				.	
microgramma, *Wright*	.	..	.	.	.		.		.	
Marchamensis, *Wright*		...	...	.					.	
Corallina, *Wright*	.	.	.					.		
tuberculosa, *Wright*	...	...	...	...	...				.	
Morrisii, *Wright*	...	...	...	...	...		.			
Cunningtoni, *Wright*		...								
Pedina rotata, *Wright*	..	...	..			*			.	
Smithii, *Forbes*		.	.		...	*			*	
Fam. ECHINIDÆ.										
Glypticus hieroglyphicus, *Goldfuss*	.	.	.	.	...					.
Magnotia Forbesii, *Wright*		..	.			*				
Polycyphus Normannus, *Desor*	...	.				*	.	*	*	. .
Deslongchampsii, *Wright*	.	.		*						
Stomechinus germinans, *Phillips*		...		*						
intermedius, *Agassiz*	.				*	*				
bigranularis, *Lamarck*	..					*				
microcyphus, *Wright*	.	..	.		...				*	
gyratus, *Agassiz*		..								
nudus, *Wright*		..								

		MIDDLE DIVISION.					UPPER DIVISION.				Observations and Foreign Localities.
Forest Marble.	Cornbrash.	Kelloway Rock.	Oxford Clay.	Lower Calc. Grit.	Coralline Oolite.	Upper Calc. Grit.	Kimmeridge Clay.	Portland Sand.	Portland Oolite.	Purbeck Beds.	
...	...	...	..	...	...	..	...	...	...	...	France.
...	*										
...	*										
...	...	...	...	*							
...	...	...	...	...	*						
...	...	...	...	...	*						
..	...	...	...	...	...	...	*				
...	...	...	...	..	...	...	*				
...	*										
...	...	...	...	..	*	...	...	...	...	...	France, Germany, and Switzerland.
...	*	...	...	...	...	...	...	...	...	...	Ranville and Luc, France.
...	*	...	...	...	...	...	...	...	...	...	Ranville, France.
...	...	...	...	...	...	...	..	...	..	...	Ranville, Port-en-Bessin, France.
...	...	...	...	...	*	...	...	...	...	...	France and Switzerland.
...	...	..		.	*						

FAMILIES, GENERA, AND SPECIES.	LOWER DIVISION.									
	LIAS.			INFERIOR OOLITE.			GREAT OOLITE.			
	Lower Lias.	Middle Lias.	Upper Lias.	Murchisonæ zone.	Humphriesianus zone.	Parkinsoni zone.	Fuller's Earth.	Stonesfield Slate.	Great Oolite.	Bradford Clay.
Fam. SALENIADÆ.										
Acrosalenia minuta, *Buckman*	*									
crinifera, *Quenstedt*	...	...	*	...	..	..	..	..	...	.
Lycetti, *Wright*	...	..	...	*	*	*				
pustulata, *Forbes*	...	..	...	..	..	...	...	.	*	..
Wiltonii, *Wright*	...	...	...	.	...	.	...	...	..	
Loweana, *Wright*	...	...	...	...	..	...	...	..	...	.
spinosa, *Agassiz*	...	...	...	..	..	*	...	..	*	...
hemicidaroides, *Wright*	...	...	.	...	..	..	...	...	*	..
decorata, *Haine*	...	...	.	...	...	...	...	..	..	..
Fam. ECHINOCONIDÆ.										
Holectypus depressus, *Leske*	..	...	..	...	..	*	...	*	*	...
hemisphæricus, *Desor*	...	...	..	...	...	*	...	...	...	..
oblongus, *Wright*	..	...	...	...	..	...	...	...	...	..
Pygaster semisulcatus, *Phillips*	..	...	.	*	...	...	...	...	*	
conoideus, *Wright*	...	...	...	*						
macrostomus, *Wright*	...	...	..	...		...	...	...	...	...
Morrisii, *Wright*	...	...	..	..	..	...	...	...	...	...
umbrella, *Lamarck*	...	...	...	...	...	...	...	...	...	...
Fam. ECHINOBRISSIDÆ.										
Echinobrissus clunicularis, *Llhwyd*	...	...	...	...	...	*	...	*	*	...
Woodwardii, *Wright*	...	...	...	...	...	...	...	...	*	
orbicularis, *Phillips*	..	...	...	...	...	...	..	...	...	..
quadratus, *Wright*	...	...	...	...	...	...	...	...	...	...
Griesbachii, *Wright*	...	...	...	...	...	...	...	...	...	..

		MIDDLE DIVISION.					UPPER DIVISION.				
Forest Marble.	Cornbrash.	Kelloway Rock.	Oxford Clay.	Lower Calc. Grit.	Coralline Oolite.	Upper Calc. Grit.	Kimmeridge Clay.	Portland Sand.	Portland Oolite.	Purbeck Beds.	Observations and Foreign Localities.
..	...	.	..	.	..	..			.	...	Pliensbach bei Boll, Württemberg.
*											
...	*										
*											
*	*	...	..	..	.	..	...	..			Ranville, Châtel-Censoir, France; and Soleure, Switzerland.
*	*										
...	..	...	.	...	*						Bar-sur-Aube, Yonne, France.
..	*	..	..	...	..	.	...				France, Germany, Switzerland.
...	.	..	..	...	...	..	.			.	France, Germany, Switzerland.
...	..	..	..	..	*						
*											
...	*										
..	...	...	...	*	*	..	..	..	..	.	Druyes, Châtel-Censoir, Coulanges-sur-Yonne, St. Mihiel, France.
*	*	...	..	...	...	..	...	..	..	..	France, Germany, Switzerland.
...	*	...	...	...	...	..	..	.	..	.	Mamers, Sarthe, France.
...	*										
...	*										

FAMILIES, GENERA, AND SPECIES.	LOWER DIVISION.									
	LIAS.			INFERIOR OOLITE.			GREAT OOLITE.			
	Lower Lias.	Middle Lias.	Upper Lias.	Murchisonæ zone.	Humphriesianus zone.	Parkinsoni zone.	Fuller's Earth.	Stonesfield Slate.	Great Oolite.	Bradford Clay.
Echinobrissus dimidiatus, *Phillips*	...	..	..	...	...	..	.		.	..
scutatus, *Lamarck*	...	..	..	...	...	.	.		...	..
Brodiei, *Wright*	..	.	...	...	..	..	..		.	.
Clypeus Plotii, *Klein*	..	...	...	...	...	*	*	*	*	..
Agassizii, *Wright*	...	...	..	...	...	*	.	..	...	.
altus, *M'Coy*	..	...	..	..	...	*	.	.	..	..
Michelini, *Wright*	..	...	.	*	*					
Hugii, *Agassiz*	...	...	.	...	...	*	..	...	...	..
rimosus, *Agassiz*	...	.	...	...	...	*				
Mülleri, *Wright*	...		...	..	...	...	...	...	*	
subulatus, *Young and Bird*	...	...	...	...	...	..	...	...	..	...
Fam. COLLYRITIDÆ.										
Collyrites ringens, *Agassiz*	..	...	...	...	...	*	...	..	.	...
ovalis, *Leske*	...	...	..	...	...	*	..	...	...	...
bicordata, *Leske*	...	...	...	...	...	...	..	...	...	...
Hyboclypus agariciformis, *Forbes*	...	...	...	*	...	...	...	...	*	
caudatus, *Wright*	...	...	..	...	...	*	...	...	...	..
gibberulus, *Agassiz*	...	...	...	...	...	*	...	...	...	...
ovalis, *Wright*	...	...	...	...	...	*				
Fam. ECHINANTHIDÆ.										
Pygurus Michelini, *Cotteau*	...	..	...	...	...	*	..	..	*	*
pentagonalis, *Phillips*	...	..	...	...	...	...	..	...	...	.
Blumenbachii, *Koch & Dunker*	...	...	...	...	...	...	...	...	..	...
Phillipsii, *Wright*	...	...	...	...	...	..	...	...	...	..
Hausmanni, *Koch & Dunker*	...	..	...	...	...	...	..	...	...	...
costatus, *Wright*	.	.	...	...	...	...	...	...	...	...

		MIDDLE DIVISION.					UPPER DIVISION.				Observations and Foreign Localities.
Forest Marble.	Cornbrash.	Kelloway Rock.	Oxford Clay.	Lower Calc. Grit.	Coralline Oolite.	Upper Calc. Grit.	Kimmeridge Clay.	Portland Sand.	Portland Oolite.	Purbeck Beds.	
..	...	...	.	...	*						
...	..	...	..	*	*	...	.	..	...	...	France, Germany, Switzerland.
...	...	...	...	..		..		...	*		
...	*	...	...			..	.	.	...	..	France and Switzerland.
..	.	...	.				.	..	.	..	Conlie, Mamers, Sarthe, France.
...	...	..	..				.	.	.	.	Pécheseul, Sarthe, France.
..	...	...	...	.	..	.			.	.	France and Switzerland.
...	..		..		*						
...	*				..	...	.			..	France and Switzerland.
..	..	...		..		.				..	France and Switzerland.
..	.	..		*	*	.	.	.		.	France and Switzerland.
..	.	.		.	.	.		...	..	..	Bayeux, France.
...	..	..		.		..	.	.	..	..	France and Switzerland.
.	*	..							..		France and Switzerland.
..				*	*						
.				*	*				.		France and Germany.
...					*						
..					*				.		France and Germany.

FAMILIES, GENERA, AND SPECIES.	LOWER DIVISION.									
	LIAS.			INFERIOR OOLITE.			GREAT OOLITE.			
	Lower Lias.	Middle Lias.	Upper Lias.	Murchisonæ zone.	Humphricsianus zone.	Parkinsoni zone.	Fuller's Earth.	Stonesfield Slate.	Great Oolite.	Bradford Clay.
Order ASTEROIDEA.										
Fam. URASTERIDÆ.										
Uraster Gaveyi, *Forbes*		*								
carinatus, *Wright*		*								
Fam. SOLASTERIDÆ.										
Solaster Moretonis, *Forbes*									*	
Fam. GONIASTERIDÆ.										
Goniaster Hamptonensis, *Wright*									*	
obtusus, *Wright*				*						
Fam. ASTERIDÆ.										
Tropidaster pectinatus, *Forbes*		*								
Astropecten Hastingsiæ, *Forbes*		*								
Orion, *Forbes*		*								
Phillipsii, *Forbes*		*								
Leckenbyi, *Wright*		...			*					
Scarburgensis, *Wright*		...			*					
Cotteswoldiæ, *Buckman*								*		
Wittsii, *Wright*								*		
Forbesii, *Wright*		...						*		
clavæformis, *Wright*										
rectus, *M'Coy*										
Luidia Murchisonii, *Williamson*		*								
Plumaster Ophiuroides, *Wright*	*									

		MIDDLE DIVISION.					UPPER DIVISION.				Observations and Foreign Localities.
Forest Marble.	Cornbrash.	Kelloway Rock.	Oxford Clay.	Lower Calc. Grit.	Coralline Oolite.	Upper Calc. Grit.	Kimmeridge Clay.	Portland Sand.	Portland Oolite.	Purbeck Beds.	
...	.		.	*							
...	.	.	...	*							

FAMILIES, GENERA, AND SPECIES.	LOWER DIVISION.									
	LIAS.			INFERIOR OOLITE.			GREAT OOLITE.			
	Lower Lias.	Middle Lias.	Upper Lias.	Murchisonæ zone.	Humphriesianus zone.	Parkinsoni zone.	Fuller's Earth.	Stonesfield Slate.	Great Oolite.	Bradford Clay.
Order OPHIUROIDEA.										
Fam. OPHIURIDÆ.										
Palæocoma Gaveyi, *Wright*	...	*								
Milleri, *Phillips*	...	*								
Egertoni, *Broderip*	...	...	*							
tenuibrachiata, *Forbes*	...	...	*							
Brodiei, *Wright*	...	...	*							
Murravii, *Forbes*	...	...	...	...	*					
Griesbachii, *Wright*	...	...	...	...	...	...	...	...	...	...
Order CRINOIDEA.										
Fam. PENTACRINIDÆ.										
Pentacrinus tuberculatus, *Miller*	*	...		...		..				..
scalaris, *Goldfuss*	*	...	..	...		..	..		.	..
basaltiformis, *Miller*	...	*		...	...	...	...	.	...	.
Goldfussii, *M'Coy*	...	*								
robustus, *Wright*	...	*								
punctiferus, *Quenstedt*	...	*			...	...	...	...	...	...
Johnsonii, *Austin*	...	...	*	...	...	...	..	...	...	...
dichotomus, *M'Coy*	...	...	*							
Phillipsii, *Wright*	...	...	*							
Milleri, *Austin*	...	...	...	...	*					
Austenii, *Wright*	...	...	...	*						
subsulcatus, *Goldfuss*	...	...	...	...	...	...	...	...	...	*
subteres, *Goldfuss*	...	...	...	...	...	...	...	...	...	*
Extracrinus Briareus, *Miller*	*	...		.	.					...
subangularis, *Miller*	...	*		...				...	.	

		MIDDLE DIVISION.					UPPER DIVISION.				Observations and Foreign Localities.
Forest Marble.	Cornbrash	Kelloway Rock.	Oxford Clay.	Lower Calc. Grit.	Coralline Oolite.	Upper Calc. Grit.	Kimmeridge Clay.	Portland Sand.	Portland Oolite.	Purbeck Beds.	
*											
...	...	...	...	...	...	...	...	...	...	...	France, Germany.
...	...	...	...	...	...	...	...	...	...	...	France, Germany.
...	...	...	...	...	...	...	...	...	...	...	France, Germany.
...	...	...	...	...	...	...	...	...	...	...	Germany.
...	...	...	...	...	...	...	...	...	...	...	France.
...	...	...	...	...	...	...	...	...	...	...	Germany.
...	...	...	...	...	...	...	...	...	...	...	Germany.
...	...	...	...	...	...	...	...	...	...	...	France, Germany.
...	...	...	...	...	...	...	...	...	...	...	France, Germany.

FAMILIES, GENERA, AND SPECIES.	LOWER DIVISION.									
	LIAS.			INFERIOR OOLITE.			GREAT OOLITE.			
	Lower Lias.	Middle Lias.	Upper Lias.	Murchisonæ zone.	Humphriesianus zone.	Parkinsoni zone.	Fuller's Earth.	Stonesfield Slate.	Great Oolite.	Bradford Clay.
Fam. APIOCRINIDÆ.										
Apiocrinus Parkinsoni, *Schlotheim* .	...	...	...	...	...	...	...	...	...	*
elegans, *Defrance* . . .	...	...	...	...	...	...	...	...	...	*
exutus, *M'Coy* . . .	...	...	...	...	...	...	...	...	...	*
Millericrinus Prattii, *Gray* . .	...	...	...	...	...	...	...	...	*	
obconicus, *Goldfuss* . .	...	...	...	...	...	...	...	...	*	
Koninckii, *Wright* . .	...	...	...	...	...	...	...	..	...	..
echinatus, *Schlotheim* . .	...	...	...	...	...	...	..	..	...	...
	10	17	12	0	49	0	1	8	28	9

166 Species.

ECHINOIDEA .....

ASTEROIDEA .....

OPHIUROIDEA .....

CRINOIDEA .....

		MIDDLE DIVISION.					UPPER DIVISION.				Observations and Foreign Localities.
Forest Marble.	Cornbrash	Kelloway Rock.	Oxford Clay.	Lower Calc. Grit.	Coralline Oolite.	Upper Calc. Grit.	Kimmeridge Clay.	Portland Sand.	Portland Oolite.	Purbeck Beds.	
...	...	...	...	...	...	...	...	...	...	...	Ranville, Mamers, France; Alsace, Germany.
...	...	...	...	...	...	...	...	...	...	...	
*											
...	...	...	...	...	*	...	...	...	...	...	France, Germany.
8	21	0	0	11	24	0	4	1	1	1	

..... 119
..... 18
..... 7
..... 22—166

From the above Tables, it appears that the English Oolitic rocks are known at present to contain 166 species of fossil Echinodermata, of which 119 species belong to the Order Echinoidea; 18 species to the Order Asteroidea; 7 species to the Order Ophiuroidea; and 22 to the Order Crinoidea. All the species belonging to the families Cidaridæ, Hemicidaridæ, Diademadæ, Echinidæ, Saleniadæ, Echinoconidæ, Echinobrissidæ, Collyritidæ, Echinanthidæ, and Echinolampidæ, have been figured in this work.

The Asteroidea, Ophiuroidea, and Crinoidea, will form the subject of a second Monograph. An analysis of the Tables gives the following distribution of the species in each stage:

Lower Lias	10	Species.
Middle Lias	17	„
Upper Lias	12	„
Inferior Oolite	49	„
Fuller's Earth	1	„
Stonesfield Slate	8	„
Great Oolite	28	„
Bradford Clay	9	„
Forest Marble	8	„
Cornbrash	21	„
Oxford Clay and Kelloway	0	„
Lower Calcareous Grit	11	„
Coral Rag	24	„
Upper Calcareous Grit	?	„
Kimmeridge Clay	4	„
Portland Sand	1	„
Portland Oolite	1	„
Marine Purbeck Beds	1	„

The Lias forms appear to be special to the three subdivisions of that formation, so well characterised by the species of Ammonites which indicate these three zones of Liassic life. The Inferior Oolite contains forty-nine species, of which forty-three are Echinoidea, three Asteroidea, one Ophiuroidea, and two Crinoidea; of these, ten species extend into the Great Oolite, and nine species pass into the Cornbrash; the Inferior Oolite has therefore thirty species which up to this time have not been found in any other formation; all the species from the Lias to the Cornbrash inclusive became extinct before the deposition of the Kelloway rock and Oxford clay. The Fuller's earth has yielded one species, and the Stonesfield slate contains eight species, several of which are special to this fissile rock. The Great Oolite has yielded twenty-eight species, of which ten extend into the Cornbrash, fourteen are special to the Great Oolite stage, and four are common to the different stages of the lower division of the Oolites. The nine species of the Bradford clay are mostly common to this argillaceous bed, and the Great Oolite limestone on which it rests. The Forest Marble contains eight species, of which four are common to this rock and the Cornbrash, which contains twenty-one species, many of

which are found in older formations; with the deposition of the Cornbrash the lower division of the Oolites terminate, and with that formation all the species of Echinodermata found in these rocks became extinct.

The middle division of the Oolites contains far fewer species than the lower. The Kelloway rock and Oxford clay, so rich in Cephalopoda, have not in England, as far as I can learn, yielded any remains of Echinodermata. The Lower Calcareous grit, Coral rag, and Upper Calcareous grit, have several species in common; of the eleven species of the Lower Calcareous grit, six are common to it and the Coral rag, which contains twenty-four species; I have not ascertained how many, if any, pass into the Upper Calcareous grit; in fact, these three stages represent in reality only one stratigraphical zone of life.

The Kimmeridge clay up to the present time is known to contain only four species, which are all special to it. There is one species in the Portland sand, one in the Portland Oolite, and one in the Marine Purbeck beds. The Portland Oolitic limestone is said to contain the remains of several Echinoderms, although I have been able to obtain only two specimens of the same species for examination from that formation.

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ARRANGED IN

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ADDITIONAL NOTES ON THE ECHINOIDEA.

Since the commencement of this Monograph in 1855, I have obtained additional information on many of the species described therein, and have lately discovered some new forms. I purpose, therefore, giving notes on the described species under their respective names, and in the same order as they were originally figured in the body of the work. The descriptions of the new species which are lithographed in the supplementary plates will be found among the genera to which they belong.

CIDARIDÆ.

Cidaris Fowleri, *Wright.* Supplement, Pl. XLII, fig. 1, *a, b, c, d, e, f.*

The fine specimen figured in this plate was found in a mass of pea-grit on Leckhampton Hill; the block containing the urchin had been long exposed to the atmosphere, and the test, in consequence, is a little weathered in parts. It has seven primary spines, more or less perfect, with several secondary spines attached *in situ* to the test. The primary spines (Pl. XLII, fig. 1 *e*) are long, slender, and nearly of a uniform diameter throughout, apparently tapering very little towards their free extremity. The head is strongly crenulated, the milled rim prominent, the neck smooth and of the same thickness as the body; the surface of the long stem is covered with short, thorn-like tubercles, which have their points directed forwards. As all the spines are more or less fractured, their proportionate length to the diameter of the test cannot be ascertained. The secondary spines (fig. 1 *f*) are small and spatulate; many of them are still adherent to the plates of the test. Fig. 1 *b* represents an inter-ambulacral plate, with its primary tubercle and circle of areolar granules; fig. 1 *c*, a profile of one of the large tubercles, showing the prominence of the crenulations; fig. 1 *d*, one of the jaws of the lantern, magnified twice.

Cidaris Smithii, *Wright.* Supplement to pages 50—52.

When I figured the very fine specimens of Pl. II, considerable doubts existed relative to the locality whence they were collected. My lamented colleague, Professor Forbes,

was impressed with the idea that they were foreign fossils, and was averse to their being drawn as British Echinidæ; the history of the specimens, however, convinced me that they were English, although their locality was then unknown. Some time after the publication of the first part of this work, I went to Oxford for the purpose of examining the late Dr. Buckland's collection, and in one of the drawers of his cabinet I saw a *Cidaris Smithii*, from the same rock as that in which my doubtful specimens were imbedded. I lost no time in visiting the locality, Bullington Green, near Oxford, whence it was obtained, where I found several plates of tests and fragments of spines of the species. From this locality Mr. Whiteaves, of Oxford, lately collected a very large specimen of *Cidaris Smithii*, which, through that gentleman's kindness, is now in my cabinet. This test measures three inches and three quarters in diameter, one third more than the largest specimen previously known, and has the jaws and teeth *in situ*. In the same stratum of Coral Rag at Bullington, I found *Echinobrissus scutatus*, Lamk., *Pygaster umbrella*, Agas., and *Pygurus pentagonalis*, Phil. I have lately obtained *Cidaris Smithii*, Wr., from the Coral Rag at Hillmarton, Wilts, where it is associated with *Cidaris florigemma*, Phil., *Pseudodiadema versipora*, Woodward, and *Pygaster umbrella*, Agass. This is the original locality whence Dr. William Smith obtained the specimen now in the British Museum.

DIPLOCIDARIS WRIGHTII, *Desor*. Pl. XLI, fig. 6, 7, Supplement to page 58.

A very fine, large specimen of this gigantic Cidaris was discovered by my friend, the Rev. T. W. Norwood, in the Inferior Oolite at Shurdington Hill, near Cheltenham. Unfortunately, I have only been able to figure one of its largest spines. This was undoubtedly, one of our largest Oolitic Cidaridæ, and, from Mr. Norwood's description, must have attained a gigantic size, as appears by the following note, which that gentleman has kindly supplied.

"The urchin, of which I sent you the fragments about a year ago, was found by me in the Pisolite of Shurdington Hill, under the following circumstances. A very thin, sandy, band divided two compact and indurated rock-masses forming a plane of easy and natural separation between them. In this band the urchin had been locked up, apparently in a state of wonderful preservation, and in the posture of life, with its equator evenly parallel to the divisional plane of the strata, and its magnificent spines (such as I have nowhere else seen) radiating regularly around it. The ground had chanced to be broken at this point for the purpose of quarrying stone for wall-making; the upper rock-bed had been removed down to the sandy band; and, in its removal, had torn the urchin in two at the equator, and carried away half the test and a corresponding number of spines. Therefore, when I came to the place and discovered the specimen, it was lying on the surface of the lower rock-bed, showing five or six large spines, which appeared to diverge from a circular space, about equal in diameter to the equatorial

section of *Cidaris Fowleri* or *C. florigemma*. On the spur of the moment and with insufficient tools I rashly attempted to detach my treasure; and as it turned out that the lower portion of the test was fast imbedded in the hard rock beneath, I had the sad mortification to fracture and destroy it. As I soon afterwards handed over to you the fragments that remained, I now leave the description of them in your hands. This urchin was associated, in the same rock-surface, with *Pygaster semisulcatus*, *Terebratula simplex*, and other equally characteristic fossils of the Cheltenham Pisolite."

HEMICIDARIS BRILLENSIS, *Wright*, nov. sp. Supplement, Pl. XLIII, fig. 2 *a*, *b*, *c*, *d*.

Test sub-globose, ambulacral areas wide, with two rows of primary tubercles, which extend over three fourths of the area; inter-ambulacral areas narrow, with two rows of small, nearly equal-sized, tubercles, ten in each row; apical disc large, plates very narrow, in consequence of the wideness of the vent; mouth-opening large, peristome divided into ten nearly equal lobes; poriferous zones narrow and much undulated; pores very much crowded at the base.

Dimensions.—Height, one inch; transverse diameter, one inch and a half.

Description.—This remarkable urchin, at first glance, resembles an *Acrocidaris*, from the size, number, and development of the tubercles on the ambulacral areas. In most of the other forms of *Hemicidaris* the semi-tubercles are limited to the basal region of the ambulacra, but in this species they extend through nearly three fourths of the area; this region of the test is likewise much wider than in other congeneric forms, in which the semi-tubercles are limited to the base of the area, and the margins thereof are occupied by rows of small granules. There are about ten tubercles, very regularly arranged, in each row; those at the base are very small, whilst the upper six pair are nearly of a uniform size, although rather smaller than the primary tubercles of the inter-ambulacra; the upper part of the area has only a few, small granules on its margin. The poriferous zones are very narrow, and extremely flexuous, winding round the border of the large semi-tubercles, and only becoming straight at the upper fourth, where they cease (fig. 2 *c*). The pores are separated by a thick septum, and there are six pairs of holes opposite each inter-ambulacral plate; they are much crowded together, in oblique rows, in the wide spaces left by the small semi-tubercles at the base of the areas.

The inter-ambulacral areas are narrow, scarcely twice the width of the ambulacra; they are occupied by two rows of primary tubercles, about ten in each row, of a moderate size, and nearly uniform magnitude throughout (figs. 2 *a*, *b*); they are raised on prominent bosses, with deeply crenulated summits (fig. 2 *c*); the areolas are transversely oblong, and confluent above and below; a double row of small granules

descends in a zigzag line down the middle of the area, and the zonal border of the plates has a single row of the same sized granules, which separates the areolas from the poriferous zones, and forms a series of crescents throughout the area (fig. 2 *c*).

The apical disc is large (fig. 2 *a*), and placed rather behind the vertex of the test; the ovarial plates are narrow (fig. 2 *d*), and the duct-holes perforated near the apices of the plates; the madreporiform body occupies, as usual, the right antero-lateral plate, which is the largest; the three anterior ocular plates rest upon the ovarial plates, with which they alternate, whilst the two posterior oculars are placed between the two postero-lateral and single ovarial plates (fig. 2 *d*); the vent-opening is very large.

The base is flat, and the mouth-opening wide; the peristome is divided into ten nearly equal-sized lobes; all the tubercles in this region are small, and the poriferous zones at the base of the ambulacral areas are very much crowded, the pores being arranged in oblique rows.

Affinities and differences.—This species differs so much in its general physiognomy from the typical forms of its congeners that it requires a careful examination to be satisfied that it is a *Hemicidaris*, the size and number of the semi-tubercles, extending as they do so high up the area, and the small and uniform magnitude of the primary tubercles, produce so many rows of tubercles on the flanks of this urchin (fig. 2 *b*, *d*), that it might readily be referred to the genus *Acrocidaris* rather than to the group to which it belongs. In *Acrocidaris*, however, the tubercles are very unequal in magnitude on the sides of the test, and each ovarial plate supports on its centre a small, primary, perforated and crenulated tubercle, a character which is quite diagnostic of this genus. The greater width of the ambulacra, and the presence of a double row of semi-tubercles, extending three parts up the sides, distinguish this species from its congeners; the smallness of the primary tubercles in the inter-ambulacra, and the increased number and nearly uniform size of the same throughout the rows, distinguish it likewise from *Hemicidaris Davidsoni*, Wr., another Portland species, with which it has many affinities.

Locality and Stratigraphical position.—This urchin was discovered in the Portland Oolite, at Brill, and was purchased from the person who collected it therefrom by my friend, the Rev. P. B. Brodie, who kindly communicated the specimen for this work; the test is rather distorted, and much concealed by a small, encrusting oyster. At the same locality my friend collected the large *Echinobrissus Brodiei*, Wr., of which I have given a figure of the natural size in Pl. XLIII, fig. 3.

DIADEMADÆ.

Genus—HETEROCIDARIS, *Cotteau*, 1860.*

Test large, circular, depressed, inflated at the sides, sub-convex above, almost flat below; the inter-ambulacral areas very wide, and provided with from six to eight rows of large, nearly equal-sized, perforated tubercles, raised on prominent bosses, with crenulated summits; the areolæ are narrow, and their circumference surrounded by a circle of small, equidistant granules, a few only of which are distributed on the intermediate surface of the plates.

The ambulacral areas are straight, very narrow, and slightly flexuous above; they are furnished with two rows of small, distinct, perforated tubercles, uniform in size, and raised on small bosses, which are placed in regular rows on the margin of the area; three tubercles occupying the depth of each inter-ambulacral plate.

The poriferous zones are narrow; the pores are small, simple, non-conjugate, and superimposed, having a slight disposition to a trigeminal arrangement near the mouth.

The mouth-opening is large and pentagonal, about one third the diameter of the test; from the narrowness of the ambulacra, the lobes of this portion of the peristome are much smaller than those of the inter-ambulacra.

The spines are long and cylindrical; their surface is covered with fine, longitudinal lines, having small, indistinct tubercles interspersed amongst them.

I refer this genus to the family Diademadæ, as I have defined it.† The size of the test, the narrowness of the ambulacra, the width of the inter-ambulacra, and the numerous rows of primary tubercles thereon, indicate that *Heterocidaris* has certain affinities with *Astropyga*, although it possesses many characters by which it is readily distinguished from that genus. *Heterocidaris* resembles some of the large forms of *Hemipedina*, as *H. Marchamensis*, Wr., but the deep crenulations on all the bosses shows it to be distinct from that form. M. Cotteau observes,‡ that the genus *Heterocidaris*, notwithstanding its resemblance to the Diademadæ, is separated from that family by a character of the first order, namely, the structure of the peristome, which is pentagonal, and furnished with ambulacral lips much more narrow than those which correspond to the inter-ambulacra, whilst in the Diademadæ the peristome is always decagonal, and notched by ten incisions more or less deep. He therefore places this genus in the family Cidaridæ of Desor, which forms, according to that author, however, a much larger group than the family Cidaridæ of this Monograph.§

* Extrait du 'Bulletin de la Société Géologique de France,' 2me série, tom. xvii, p. 378, pl. iv.

† See p. 18 of this Monograph.

‡ Extrait du 'Bulletin de la Société Géologique de France,' 2me série, tom. xvii, p. 380, pl. iv.

§ See p. 18.

Heterocidaris Wickense, *Wright*, nov. sp. Supplement, Pl. XLIII, fig. 5 *a*, *b*, *c*.

The only portions of this urchin I have seen were some fragments I found in the collection of my friend, Mr. Leckenby, of Scarborough, and which were collected from a sandy bed of Inferior Oolite at Blue Wick, near Robin Hood's Bay, on the Yorkshire coast. The fragment figured consists of four plates (fig. 5 *a*), representing one half of an inter-ambulacral area. There are three rows of large, equal-sized tubercles on each plate, which are perforated; the bosses are prominent, and their summits deeply crenulated (fig. 5 *c*); the narrow areolæ are surrounded by a circle of small granules; other granules are likewise sparsely scattered over the intermediate surface of the plates. This is the urchin which Professor Phillips refers to in his work on 'The Geology of Yorkshire,' of which he figures a single tubercle (pl. xi, fig. 2), and catalogues, at page 155, as a Cidaris from the Dogger of Blue Wick.

The only *Heterocidaris* known to M. Cotteau was obtained by M. Triger from the Inferior Oolite of Chevain (Sarthe). This magnificent specimen (*Heterocidaris Trigeri*, Cot.) has been figured in the 'Bulletin de la Société Géologique de France,' 2me série, t. xvii, p. 378, pl. iv, and likewise in the 'Échinides du département de la Sarthe,' pl. lvi. M. Babeau has collected a fragment of another test from the Inferior Oolite of the environs of the Langres (Haute-Marne), from a rock which contained *Cidaris spinosa* and *C. Courtandina*.

Pseudodiadema lobatum, *Wright*, nov. sp. Pl. XLI, fig. 3 *a*, *b*, Supplement.

Test depressed; ambulacral areas narrow; inter-ambulacra wide, with two prominent rows of primary tubercles; spines long, smooth, and pin-shaped; neck, ring, and head covered with fine, longitudinal lines; stem smooth and uniform in thickness, tapering only near the point.

Dimensions.—Indeterminate.

Description.—This small urchin was found at Pinhay Bay, near Lyme Regis, in a thin band of marl appertaining to the zone of *Ammonites planorbis*. All the specimens I have hitherto seen are so imperfect that they are insufficient for drawing up a complete diagnosis of the species.

The ambulacral areas are narrow, but as all the specimens I have seen are unfortunately fractured through this region, the number and size of the tubercles thereon cannot be examined.

The inter-ambulacral areas are wide and well-developed, possessing two rows of large, primary, perforated tubercles, raised on prominent bosses, with deeply crenulated summits; they are surrounded by wide areolas, bounded by a defined margin, and encircled with microscopic tubercles, which impart an ornamented character to the test.

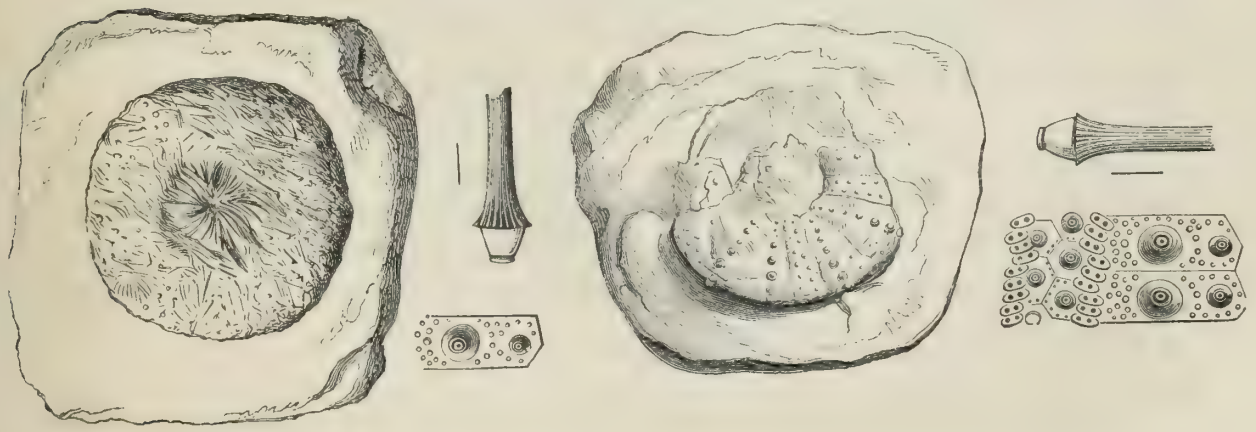
The spines are long and slender, the head is stout, the margin of the acetabulum deeply crenulated (fig. 3 *b*); the milled ring prominent, the neck short, and both are sculptured with fine, longitudinal lines; the long, slender stem is nearly of the same thickness throughout, tapering to a point near the extremity. The proportionate length of the spine to the diameter of the test cannot be ascertained, for, although entire individual spines are abundant in the marl, those attached to the test are nearly all fractured.

Affinities and differences.—As *P. lobatum* is the oldest representative of the genus Pseudodiadema, in the Oolitic rocks, it is unfortunate, from the crushed state in which the test is found, that a critical comparison cannot be made between this species and its other Oolitic congeners. The very narrow ambulacra have few tubercles thereon, but as all the tests I have examined are fractured across this part, the details of its structure cannot be seen. The affinities between this urchin and some of the depressed *Acrosalenias* is considerable, and the length of the spines in proportion to the size of the test renders that relation still more remarkable.

Locality and Stratigraphical position.—This urchin was recently discovered at Pinhay Bay, near Lyme Regis, in a bed of mottled clay, on the shore at low-water mark; many tests were found together, with numerous long, slender spines strewed in abundance amongst them; some of the spines were attached to their respective tubercles, so that the identity of the spines is satisfactorily proved. This bed of clay appertains to the lower division of the Lower Lias, and may probably correspond to a similar urchin vein found in Warwickshire and Gloucestershire, at the base of the zone of *Ammonites planorbis*.

HEMIPEDINA TOMESII, *Wright*, nov. sp.

Hemipedina Tomesii, Wr. *Hemipedina Tomesii*, Wr.



Test circular, depressed; ambulacral areas wide, with two rows of small tubercles on the margin of the area, set moderately distant apart; poriferous zones narrow; pairs of pores superimposed in groups of threes; inter-ambulacral areas with two rows of primary tubercles on the centre of the plates, and two rows of secondary tubercles internal to the primaries, which extend from the base and sides above the equator; areolæ wide, encircled by granules which likewise cover the surface of the plates. Spines long, slender, and needle-shaped; surface covered with fine, longitudinal lines.

Dimensions.—Height unknown; transverse diameter, one inch and two tenths.

Description.—The specimens of this urchin hitherto found are so much crushed and broken that it is impossible to make an accurate description of the species. The test is circular and depressed; the ambulacra are one third the width of the inter-ambulacra, and provided with two rows of small tubercles, which occupy the margin of the area; they are placed at a distance equal to the diameter of their areolæ apart from each other, and a delicate, zigzag line of small granules descends down the centre of the area; the poriferous zones are narrow, and in their upper part the pairs of holes manifest a disposition to a trigeminal arrangement, the inclination of the rows being upwards and outwards, the reverse of the direction in the genus *Pedina*. There are four or five pairs of holes opposite one large plate. The inter-ambulacral areas are three times as wide as the ambulacra at the circumference; one complete row of primary tubercles occupies the centre of the plates, and one incomplete row the inner portion thereof; the latter extend from the base and sides to two plates above the circumference. The primary tubercles at the equator have prominent bosses, which diminish in size on the upper surface; the areolæ are wide, smooth, well defined, and confluent above and below, laterally they are bounded by semicircles of small granules; at the zonal side of the plates there are three or four rows of the same-sized granules, and they likewise form circles around the incomplete rows on the centre of the area. The spines are slender and needle-shaped; the milled ring is prominent, and the surface of the stem covered with well-marked, longitudinal lines. All the specimens I have seen lie on their base on the matrix, and in none of them is the apical disc preserved.

Affinities and differences.—This urchin is much larger than *Hemipedina Bowerbankii*, Wr., which was collected from the same zone of the Lower Lias, near Lyme Regis. It resembles *Hemipedina seriale*, Leym. (Pl. IX, fig. 3 *a*), from the Lower Lias of France, but the inner row of tubercles in the inter-ambulacra are more developed and have a greater extension in that species.

Locality and Stratigraphical position.—This urchin was discovered by Mr. R. Tomes

on a slab of Lower Lias, at Binton, in Warwickshire,* and in the White Lias at Stoneythorpe, in the same county. The rock at Binton which contained this urchin comes from the base of the zone of *Ammonites planorbis*, and is known to the workmen as the Guinea Bed. It contains the bones of Saurian reptiles, &c., with the shells of *Avicula longicostata*, Stutch, *Lima punctata*, Sow., *Ostrea liassica*, Strick., and a small Coral. It may be justly considered as one of the basement beds of the Lower Lias, and this Hemipedina one of the earliest forms of the DIADEMADÆ in the Liassic rocks.

PEDINA SMITHII, *Forbes*. Supplement, Pl. XLI, fig. 2 *a*, *b*, *c*; Pl. XLIII, fig. 1 *a*, *b*, *c*, *d*.
See pages 176-178, 'Monograph.'

PSEUDOPEDINA NODOTI. Cotteau, Revue et Magasin de Zoologie, No. 5, 1858, pl. ii, figs. 4—7.

Since I figured the original specimen of this species (Pl. XIII, fig. 2), which was collected by Dr. William Smith from the Inferior Oolite at Tucking Mill, I have met with two specimens from the Inferior Oolite, near Cheltenham; one from the Great Oolite near Cirencester, and one from the Cornbrash at Islip, near Oxford. One of the Inferior Oolite specimens was obtained from the Oolite marl near the Seven Springs, and is figured in Pl. XLI, fig. 2. The inter-ambulacral areas are very wide, and the plates composing them large; on the sides and upper surface there is only one row of primary tubercles situated very near the poriferous zones (fig. 2 *b*), and all the inter-tubercular space is covered with very small granules. The ambulacral areas are narrow, and taper much; the tubercles are few in number, very small, and sparsely distributed on the upper part of the area, but are larger and more numerous below. The proximity of the primary tubercles to the poriferous zones, the narrowness of the ambulacra, and the sparse distribution of tubercles thereon, with the wide space down the middle of the inter-ambulacra, which is occupied entirely with small granules, produce a remarkable physiognomy in this urchin.

The specimen from Oxfordshire was discovered by Mr. Whiteaves in the Cornbrash at Islip, and was presented by him to the Oxford Museum. I have figured this beautiful fossil in Pl. XLIII, fig. 1; as it is much more depressed than the Inferior Oolite varieties, although it evidently belongs to the same species; the base is flat, the mouth-opening large, and the peristome deeply divided by notches (fig. 1 *b*); the tubercles are much more abundant at the base (fig. 1 *b*), a second row occupying the middle of the inter-am-

* The reader is referred for a detailed description of this section to the author's memoir, 'On the Zone of *Avicula contorta*, and the Lower Lias in the South of England.' "Quart. Journ. of the Geol. Soc.," vol. xvi, p. 394.

bulacra in this region of the test; these, however, are limited to the base, for on the sides (fig. 1 *c*) and upper surface (fig. 1 *a*) there is only a single row of tubercles; at the base of the ambulacral areas the tubercles are larger, and the pores, closely packed together, lie obliquely across the zone in groups of threes (fig. 1 *d*).

Stratigraphical distribution.—I know this urchin from the Pea Grit and Oolite Marl, zone of *Ammonites Murchisonæ*, Inferior Oolite, from Crickley Hill, and the Seven Springs, near Cheltenham.

The specimen from the Great Oolite near Cirencester was almost entirely denuded of its test, but the position of the tubercles near the poriferous zones served to identify the species. This specimen was collected by Mr. Bravender, and kindly communicated for this work.

The Cornbrash specimen is circular, and much more depressed than any of the other varieties. It has enabled us to describe and figure correctly the entire external structure of this singular form.

Dr. Smith's specimen had a very marked pentagonal base, and although this character is absent in most of the specimens I have examined, still I have found the pentagonal outline to characterise one specimen from the Pea Grit and one from the Oolite Marl.

M. Cotteau recognised the resemblance which exists between this urchin and *Pedina Bakeri*, Wr., but the absence of a good figure of *Pedina Smithii*, Forbes, rendered it impossible for that learned author to discover the identity of his *Pseudopedina Nodoti* with *Pedina Smithii*. The excellent figures which I have now given will show that the French and English forms belong to the same species. M. Cotteau found the specimen figured by him in the Museum of Dijon; it was obtained from the Étage Bathonien, route de Fauge (Côte-d'Or), where it is very rare.

SALENIADÆ.

ACROSALENIA PUSTULATA, *Forbes*. Supplemental to pages 242-245.

I am indebted to Frederick Bravender, Esq., for the following notes on the discovery, in December, 1858, of a bed of marl in the Great Oolite near Cirencester, which contained immense numbers of *Acrosalenia pustulata*. He remarks—"We have discovered an extraordinary urchin-bed in a quarry near the town, but unfortunately the urchins are nearly all of the same sort. They occur in a marly bed in the Great Oolite, about four inches above the clay bed. I have now as many as 500 specimens, and might have got 1000 if I wanted them, as they were as thick as bees in a hive. If the bed extends any further, which will be ascertained when the quarrymen proceed, any quantity might be obtained.

The following section will afford an idea of the relative position of this marly vein with its *Acrosoleniæ*.

Section of the Urchin Quarry near Cirencester.

No. 1.	Bradford Clay representative, with *Terebratula digona*, Sow.	Six feet.
2.	Great Oolite.	Six feet.
3.	Marly Vein, with *Acrosalenia pustulata*, Forb.	Two inches.
4.	Band of Stone.	Four inches.
5.	Clay Bed.	Two feet.
6.	Great Oolite.	

"The bed No. 3 is the one where the urchins *Acrosalenia pustulata*, Forbes, occur. The only other specimen of a different kind is *Holectypus depressus*, Lamk. The beds Nos. 2, 3, 4, and 5 have been called Forest Marble, which we do not approve of, as bed No. 2 is as decidedly freestone as the bed No. 6."

Thomas C. Brown, Esq., of Cirencester, has likewise kindly furnished me with the following note on this remarkable urchin-bed. He says—"In January, 1859, a great number of the *Acrosalenia pustulata* were found at Cirencester in the Great Oolite, eight or ten feet below the top of that stratum. A space of four or five yards square, two inches thick, was filled with this urchin, about 1000 in every superficial yard. They were found one upon another, about three deep, in a bed of white, marly clay. The tests were filled with this clay, and were found in a high state of preservation, with their spines recumbent upon them. It is presumed that this species is gregarious, and that a shoal of them were choked in a stream of mud; that they fell down together with the mud upon the Oolitic Rock then in course of formation, and were covered up with subsequent deposits of Oolitic matter. This species is not numerous in this district. The tests vary in size and shape, probably from a difference in age and sex, and there is great diversity in the form and number of the plates forming the apical disc. After repeated washings of the clay in water, fragments of the test were found, with broken spines of the larger and smaller ones; some of the latter are of a purple colour, many loose teeth, and one perfect set, together with Oolitic grains, but scarcely any other fossil."

ACROSALENIA PARVA, *Wright*, nov. sp.

Ambulacral areas with two rows of small marginal tubercles; inter-ambulacral tubercles large at the equator, and small on the upper and under surfaces; mouth opening wide, indistinctly decagonal, spines long and hair-like.

Dimensions.—Transverse diameter of the largest test two lines; height unknown.

Description.—The ambulacral areas of this Acrosalenia are moderately wide with two rows of small, perforated tubercles on the margins of the areas, a smaller tubercle alternating with a larger one throughout the row. The poriferous zones are narrow, and the holes large and distant from each other. The inter-ambulacral areas are wide, the plates have a single row of primary tubercles near their zonal sides, the tubercles near the equator are large, and raised on prominent bosses with crenulated summits; the areolæ are narrow, and confluent above and below, a semicircle of microscopic tubercles encircles the boss on its zonal side, and a zig-zag line of tubercles occupies the middle of the area which forms similar crescents on the sutural side of the areolæ; all these microscopic tubercles are perforated, a fact which can only be ascertained by the aid of a microscope with a half-inch object glass. The crenulations on the summit of the large bosses, when seen in profile with the microscope, resemble a circle of beads around that prominence.

The mouth-opening is wide, and indistinctly decagonal. The long, fine, and hair-like spines are scattered in profusion over the surface of the slab. When examined with a half-inch object glass, their surface is seen to be covered with sharp longitudinal lines, having an indistinctly undulated edge.

Affinities and differences.—This species differs from *Acrosalenia minuta* of the Lower Lias in having the ambulacral areas much better defined, and the tubercles of the inter-ambulacra larger and more prominent. Although a very small urchin, its generic characters are well marked; in the general neatness of its test it resembles some of the young forms of *Acrosalenia spinosa*, Ag., from the Cornbrash; this urchin affords another of those examples, so numerous among the Echinodermata, that the earliest forms of genera are, in general, those in which the typical characters of the group are best developed.

Locality and Stratigraphical position.—This small urchin was found by Mr. Tomes, who has kindly communicated it for description in the Lower Lias of Warwickshire, in the zone of *Ammonites obtusus*, it was associated with *Ammonites Birchii*, Sow., and has numerous small Gasteropoda and Conchifera imbedded with it on the same slab. It is the oldest *Acrosalenia* that has yet been found in the Lower Lias.

ECHINOCONIDÆ.

PYGASTER SEMISULCATUS, *Phillips*. Pl. XLIII, fig. 6, Supplement to pages 275-78.

Professor Phillips found in the Inferior Oolite of Whitwell the original specimen of *Pygaster semisulcatus;* from the outline of the vent of that figure, it is still, however, doubtful whether the urchin he figured in Pl. III, fig. 17, of his 'Geology of Yorkshire,' was a Whitwell specimen. I am of opinion that it was *Pygaster umbrella*, Ag., from the Coralline Oolite of Ayton or Hildenley that formed the type, and not a Whitwell specimen at all. At that time, and for long afterwards, both urchins were considered to belong to one species, and it is very probable that, as much finer specimens of *Pygaster* were collected from the Coralline Oolite than had been obtained from Whitwell, a specimen from the Coralline Oolite was preferred for the drawing. I have shown in my articles on these two species how perfectly distinct *Pygaster semisulcatus* is from *Pygaster umbrella*, and any one carefully comparing our description with Professor Phillips's figure will at once discover that the vent-opening in his drawing is the keyhole-shaped vent of *P. umbrella*, and not the wide opening of *P. semisulcatus*.

Having lately found a very good specimen of the true *Pygaster semisulcatus* from the Inferior Oolite of Whitwell in the collection of my friend, C. W. Strickland, Esq., of Hildenley, I have figured a portion of the posterior view of this urchin, with the view to exhibit the form of the vent-opening. It will be observed that this aperture is much smaller than the vent-opening of *P. semisulcatus* from the Inferior Oolite of Gloucestershire (Pl. XIX, fig. 1), and does not extend so far down the single inter-ambulacrum as in that specimen; the tubercles are likewise more sparse upon the Yorkshire urchin, and the mouth-opening is relatively smaller. It is important to note these characters, as they belong more to varieties of a given type than to a new specific form, and serve to teach us that, before the history of a species can be fully written, it is necessary to collect different individuals of the same species from localities widely apart, in order that we may estimate the degree of variation which changes of physical conditions were capable of exercising on the secondary characters of specific forms.

PYGASTER MACROSTOMA, *Wright*. Supplement, Pl. XLI, fig. 4 *a*, *b*, *c*; fig. 5 *a*, *b*.

Test depressed, pentagonal; anal opening large, wide, occupying nearly two thirds of the single inter-ambulacrum; sides tumid, base convex from the peristome to the border, mouth-opening large, one fourth the diameter of the test.

Dimensions.—Height, seven tenths of an inch; transverse and antero-posterior diameters of the test nearly equal, two inches.

Description.—This urchin is remarkable for the length and width of the anal aperture, and for the great size of its mouth-opening; it is likewise much depressed and pentagonal, and covered with very small tubercles, sparsely distributed on the plates (fig. 5 *a*); in these respects it presents an assemblage of characters which, taken together, produce a form very different to any of the many varieties of *Pygaster semisulcatus* which have hitherto passed through my hands; for these reasons I have separated it from them under a distinct name. Knowing, however, the wide variations which many species exhibit in different individuals, and how necessary it is to possess examples of a series of these forms for comparison. I am most reluctant, in the absence of such materials, to multiply specific names. Still, for the sake of clearness, the provisional name *macrostoma* is proposed for this form.

Having only seen three or four examples of *Pygaster macrostoma*, the evidence, to my mind, is not sufficient to write positively on the subject, although all these specimens were remarkable for the great size of the two openings in the test.

Should a number of specimens of this urchin be hereafter gathered, and carefully compared with each other, it will then be seen whether the characters I have pointed out are persistent in the group, or shade off into forms, which may blend with other varieties of *Pygaster semisulcatus*. In the mean time it is right to register this urchin under a provisional name, and wait for the future discovery of more specimens for determination. The one proposed indicates its characters.

Part of the apical disc is preserved in a smaller specimen (fig. 5 *b*); it consists of four ovarial plates, the right antero-lateral supporting the madreporiform body being the largest, the single ovarial plate is absent in this specimen; the five small heart-shaped ocular plates are wedged in the interspaces between the ovarials (fig. 5 *b*), forming a crescent around the sub-compact disc; the posterior margin of the plates is free (fig. 5 *b*); it does not appear, however, in what manner the anal membrane and plates were connected therewith.

Locality and Stratigraphical position.—This urchin was collected in a bed of sandy Oolite, near Hampen, but whether it belongs to the Inferior Oolite or Cornbrash, I have, at present, no means of determining.

GALEROPYGUS AGARICIFORMIS, *Forbes.* Supplement, Pl. XLII, fig. 2 *a* and fig. 3, pages 292-95.

GALEROPYGUS AGARICIFORMIS. Cotteau, Bulletin Soc. Géol. de France, 2me série, tom. xvi, p. 289.

Although many hundreds of specimens of this urchin had passed through my hands when I described the species, still I had not then seen any traces of the apical disc; I was, therefore, unable to give any opinion upon M. Cotteau's proposal to separate into a distinct genus, under the name *Galeropygus*, those *Hyboclypi* which possessed a sub-compact and not an elongated disc. Very lately, however, I met with two specimens of this urchin which possessed portions of the disc *in situ*, and these form the subjects of figs. 2 and 3 of the Supplemental Pl. XLII.

The four ovarial plates, which are of a rhomboidal figure, are arranged in a crescentic form around the concave, anterior opening of the round, discal aperture; the right antero-lateral plate is the largest, and supports the madreporiform body; the plates are small, and externally present acute angles, which are inserted into the V-shaped notches of the inter-ambulacral segments of the discal opening; the foramina for the ovarial tubes are at the extreme point of the angle, and in some almost marginal. Four of the ocular plates are very small, and intercalated between the angles of the ovarial plates; the left postero-lateral is larger than the others, and wedged between the two left lateral ovarials, and all the orbits are distinctly marginal (fig. 3). The posterior part of this singular structure is absent, and it does not appear in what manner the single ovarial was articulated with the others, nor how the membrane of the vent, with its anal plates, was united to the test.

M. Cotteau first proposed the separation of *Hyboclypus disculus*, Ag., into the genus *Galeropygus*, from observing the difference which the disc of that urchin presented when compared with the true type form of the genus, *Hyboclypus gibberulus*, Ag.

The apical discs of the ECHINOIDEA EXOCYCLICA may be arranged, as M. Cotteau observes, into three groups—1st, *compact;* 2d, *sub-compact;* and 3d, *elongated.*

The disc is said to be *compact* when the ovarial plates form a circle around the madreporiform body, and when the five small ocular plates are intercalated between the angles formed by the ovarial plates, as in *Holectypus*, *Clypeus*, *Galerites*, and *Echinoconus*.

The disc is *sub-compact* when the three anterior ocular plates are intercalated between the angles of the ovarial plates, whilst the two posterior ocular plates are longitudinally on the same line as the postero-lateral ovarials; sometimes the single plate is altogether wanting; but it is oftener represented by two or three small, complementary, imperforate pieces, which reach the madreporiform body. This disposition of the plates gives the disc a sub-circular form, such as is seen in *Pyrina* and *Galeropygus*.

The disc is *elongated* when the four ocular plates, the anterior, lateral, and posterior, are longitudinally on the same line with the ovarials. The single ovarial plate is sometimes absent, as in the sub-compact disc; it is oftener, however, represented by one or many small, irregular, and imperforate complementary pieces, as in *Hyboclypus* and *Collyrites*.

The discs which I have discovered in *Galeropygus agariciformis* and *G. caudatus* undoubtedly belong to the sub-compact group, and justifies M. Cotteau in removing them into the genus he has established for their reception.*

ECHINOBRISSIDÆ.

Clypeus Plotii, *Klein*. Pl. XLIII, fig. 4 *a*, *b*, Supplement to page 364.

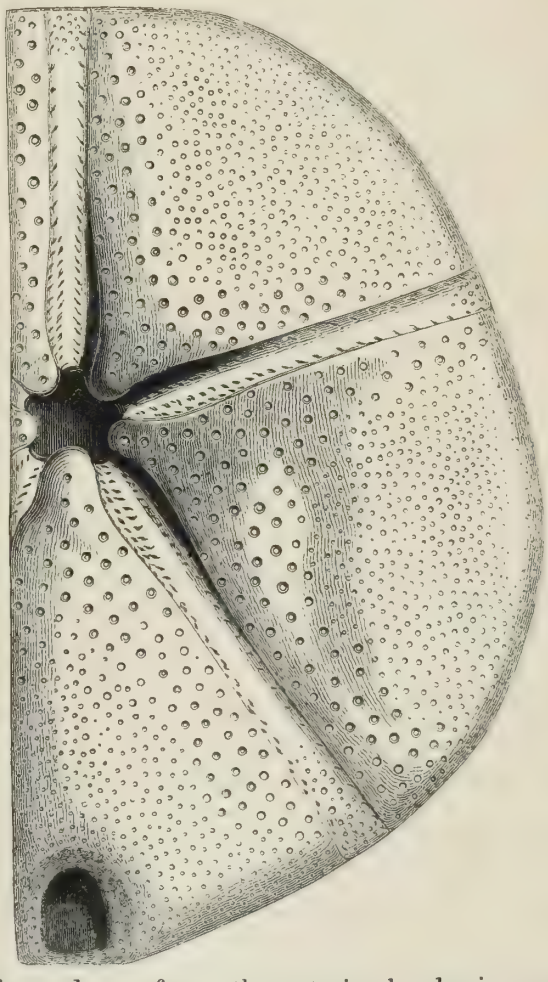
Previous to the publication of the figures and description of *Clypeus Plotii* in this Monograph, no notice had been taken by former authors that the small tubercles of this urchin were perforated; the specimen I figured was supposed by some to have been exceptional rather than typical, as several accurate observers had failed to verify Mr. Bone's figures. Accordingly I exposed several specimens of *Clypeus Plotii* on my garden-wall during two winters, and effectually weathered the surface of their tests; by this process I have ascertained, that all the tubercles on the inter-ambulacra, and likewise on the ambulacra, including even the minute granules ranged on the edge of the zonal septa, are perforated. I have in fig. 4 *a* represented a portion of the upper surface of this urchin, of the natural size, and in fig. 4 *b* given a magnified view of one of the plates thereof; the bosses of the tubercles, with their deep-encircling areolæ, and the perforation of the summits, are well represented in this drawing, together with the miliary granules which are freely scattered over the surface of the test. The form and structure of the apical disc are likewise well seen in fig. 4 *a*; the elements of this compact disc are covered by the madreporiform body, which in this species extends over the surface of all the genital and ocular plates, the only indication of these bodies being the five orbits at the summits of the ambulacra and the four openings of the genital ducts opposite the inter-ambulacra; the spongy structure of the madreporiform body is likewise beautifully exemplified in this weathered specimen.

* For ample details on the genus *Galeropygus* the reader is referred to M. Cotteau's excellent memoir on that new genus, in the 'Bulletin Soc. Géol. de France,' 2me série, t. xvi, p. 289.

ECHINOLAMPIDÆ.

PYGURUS HAUSMANNI, *Koch and Dunker*. Pl. XXXIX, XL to Supplement, p. 405.

Pygurus Hausmanni.



In all the specimens of this large urchin hitherto found it is the upper surface alone that is exposed. My friend, W. C. Strickland, Esq., having met with an uninjured test, he determined to remove the matrix from the base, with the intention of showing the mouth- and vent-openings; this he has succeeded in doing, and I am now, through his kindness, enabled to give a figure of the under surface and complete the description of this remarkable species.

The base is concave, inclining on all sides towards the mouth-opening, which is nearly central, being only three tenths of an inch nearer the anterior border; the peristome is pentagonal, and surrounded by five lobes, which are moderately prominent; the ambulacral valleys are slightly depressed, and converge in straight lines to the mouth; the wide inter-ambulacra are convex near the margin, and, with the depressed ambulacra, present a series of gentle undulations throughout the under surface; the anterior border is rounded, without any trace of anteal sulcus; the anal-opening lies in a deep, oblong depression near the posterior border; the test is very thin, and the tubercles in this region are very small; the apical disc is well preserved, and is only two lines in diameter; the small ovarial plates are closely soldered together, and covered by the madreporiform body which entirely envelopes the disc, and appears like a central spongy button at the vertex; the four oviductal holes are visible, and alone indicate the extent of the plates; the ocular plates are not visible, mere depressions only showing their position.

This specimen was collected from the Coralline Oolite at Settrington, near Malton, whence several good specimens have been obtained; the oolitic rock is here very fine, and cuts almost as white as chalk. Coral banks are likewise very abundant in this locality, and the fineness of the Oolite is probably due to the coralline mud which abounded in the vicinity of these *Anthozoa*.

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ON THE

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PLATE XXXVII.

Pygurus Costatus, *Wright.*

From the Coralline Oolite.

1 *a.* Pygurus Costatus, *Wright*, p. 397. Upper surface, natural size.

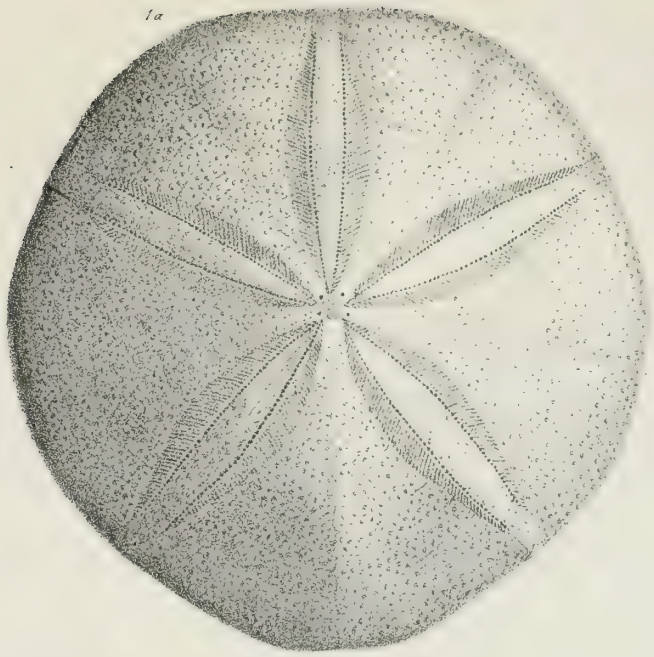
b. Under surface of the same test, natural size.

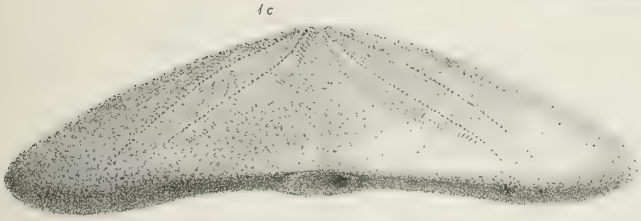
c. Posterior view, showing the flatness of the base and the extreme depression of the upper surface.

d. Two inter-ambulacral plates, poriferous zones, and ambulacral area, magnified three times.

e. Phylloidal expansion of the ambulacral area near the mouth-opening, showing the crowding together of the pores in this region, magnified three times.

f. One of the lip-like processes of the mammillated, oval lobes which project over the border of the peristome, magnified twice.





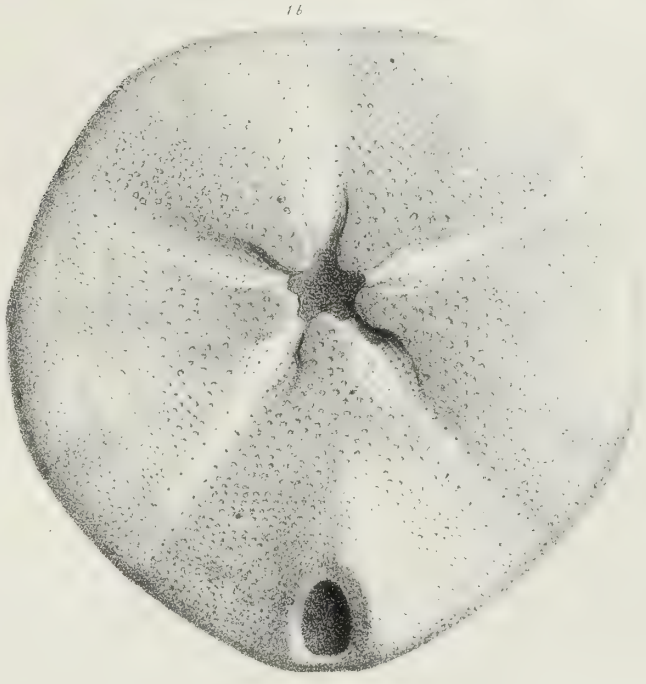


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PLATE XXXVIII.

PYGURUS BLUMENBACHII, *Koch and Dunker.*

From the Coralline Oolite.

1 *a*. PYGURUS BLUMENBACHII, *Koch and Dunker,* p. 400. Upper surface, natural size.

b. Under surface of the same test, natural size.

c. Posterior view of ditto, showing the undulations of the base and the elevation of the dorsal surface.

d. Lateral view of ditto, showing the great elevation of the anterior half of the test, and the eccentricity of the vertex.

e. Tubercles from the base, with their hexagonal areas.

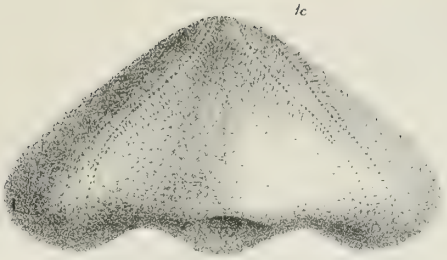
2 *a*. Upper surface of another specimen in my collection.

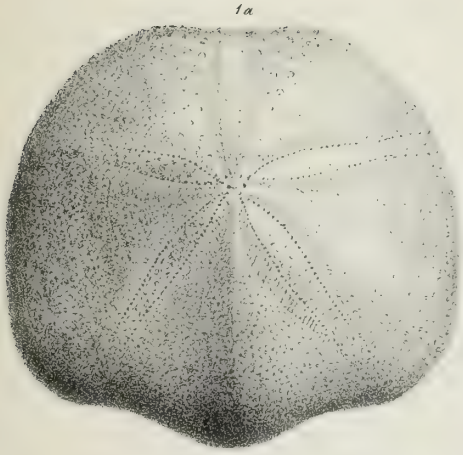
b. Two inter-ambulacral plates, a portion of the poriferous zones, and ambulacral area, magnified four times.

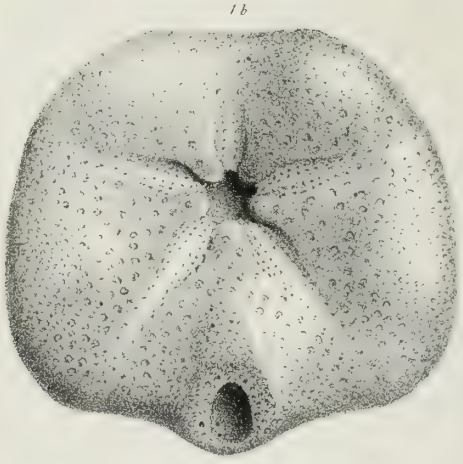
c. Apical disc and madreporiform tubercle, magnified.

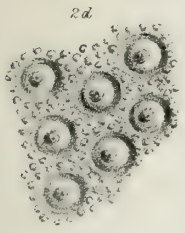
d. Tubercles from the upper surface, greatly magnified.

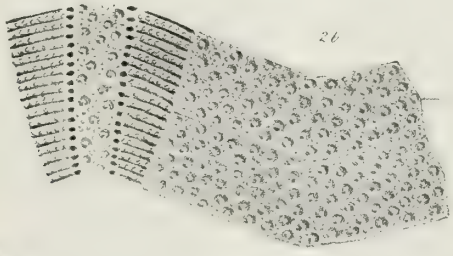
3. Apical disc from a French specimen after M. Cotteau, showing the size and arrangement of the plates.

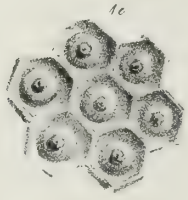


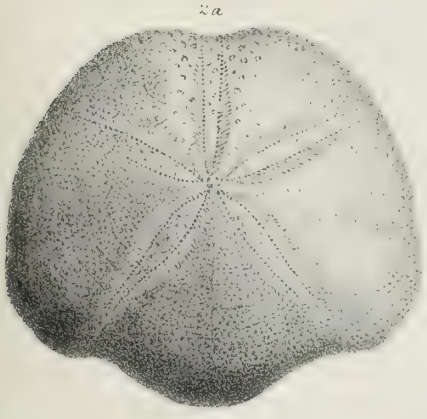












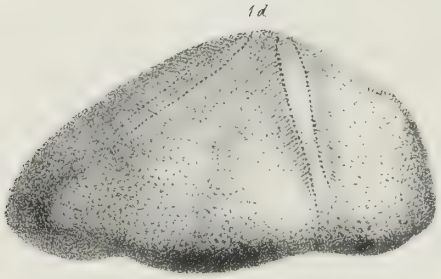


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PLATE XXXIX.

Pygurus Phillipsii, *Wright.*

From the Coralline Oolite.

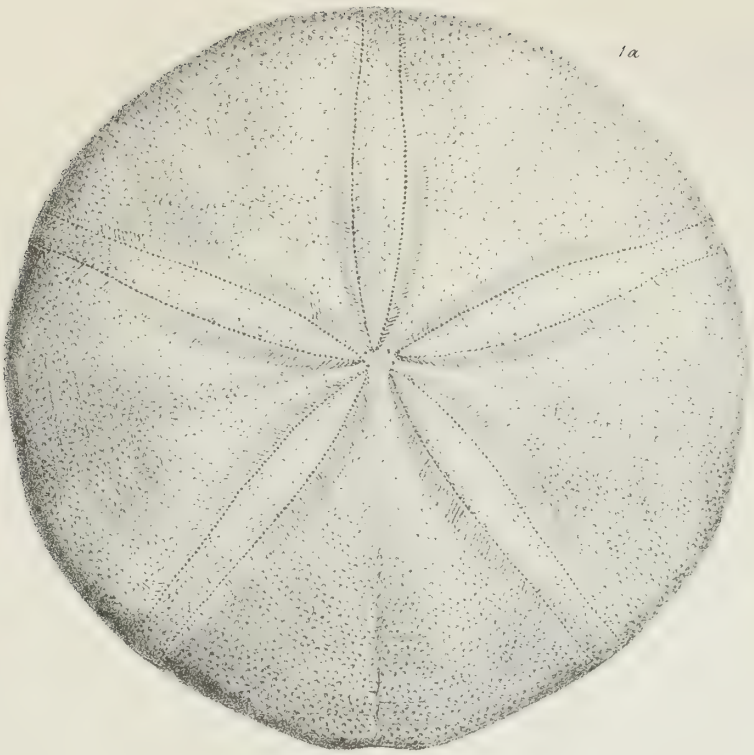
1 *a*. Pygurus Phillipsii, *Wright*, p. 403. Upper surface, natural size.

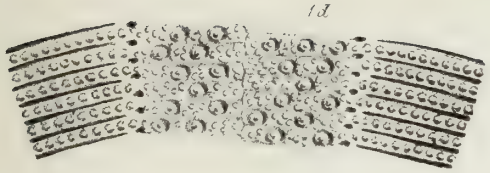
b. Posterior view of the same test, showing the depression of the upper surface and the undulation of the base.

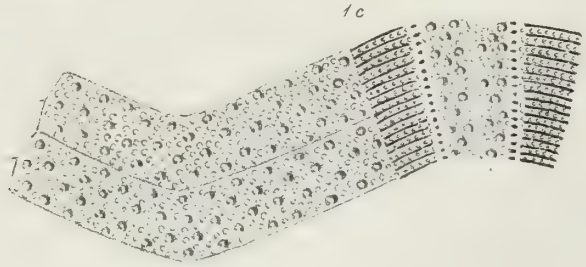
c. Two inter-ambulacral plates, a portion of the poriferous zones, and ambulacral area, magnified three times.

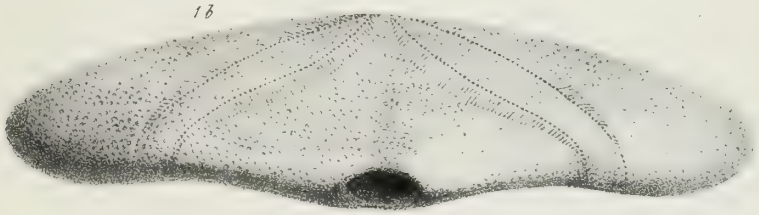
d A portion of an ambulacral area, with its poriferous zones, magnified eight times.

2. Pygurus Hausmanni, *Koch and Dunker*, p. 405. Two of the inter-ambulacral plates, a portion of the poriferous zones, and ambulacral area, magnified three times.









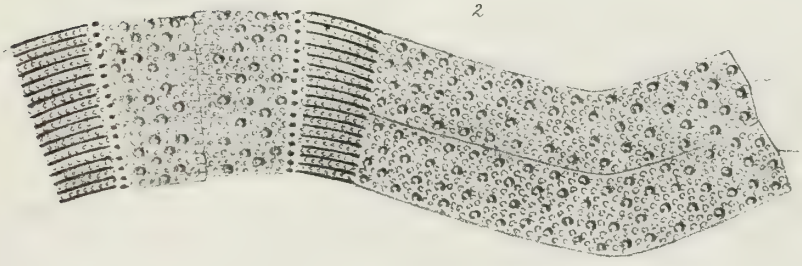


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PLATE XL.

PYGURUS HAUSMANNI, *Koch and Dunker.*

From the Coralline Oolite.

PYGURUS HAUSMANNI, *Koch and Dunker*, p. 405. The upper surface restored, natural size. Most of the adult specimens of this largest British Oolitic urchin are fractured and distorted, but some of the smaller individuals show the true outline of the test.

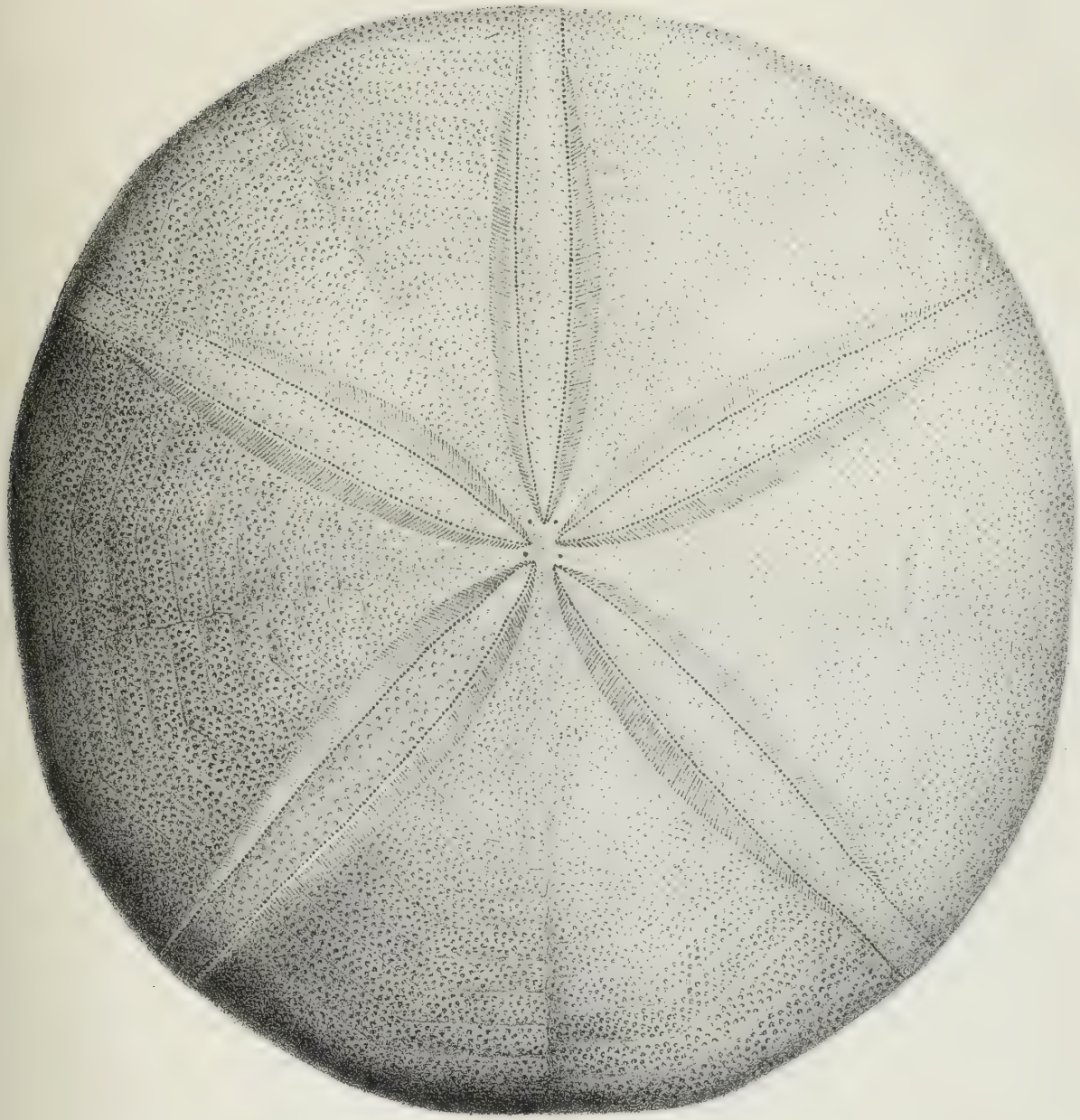

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PLATE XLI.

1 *a*. Nucleolites recens, *Edwards*. The living representative of this group from Australia, showing the test and spines copied from Professor Milne-Edwards' figure in the illustrated edition of Cuvier's 'Règne Animal Zoophytes,' tab. xiv, fig. 3.

b. The anal aperture, and its surrounding anal plates.

2 *a*. Pedina Smithii, *Forbes*, p. 176. Upper surface of the test, natural size.

b. Inter-ambulacral plate, portion of the poriferous zones, and ambulacral area, magnified three times.

c. Three pair of pores, greatly magnified.

3 *a*. Pseudodiadema lobatum, *Wright*. Fragments of tests, with spines, on a slab of Lower Lias shale from Pinhay Bay.

b. Spine of the same, magnified.

4 *a*. Pygaster megastoma, *Wright*, n. sp. Upper surface, natural size.

b. Under surface of the same test, natural size.

c. Lateral view of ditto, ditto.

5 *a*. Two inter-ambulacral plates, poriferous zones, and ambulacral areas, of another specimen of the same species.

b. Apical disc of a small specimen of *Pygaster megastoma*, Wr.

6. Large spine of Diplocidaris Wrightii, *Desor*.

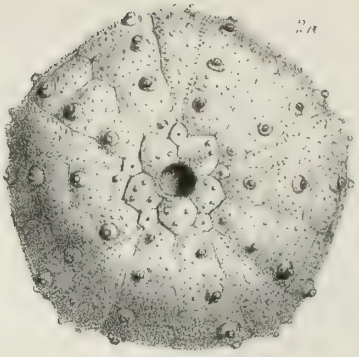
7. Spine of Cidaris pustulata, *Wright*, with a portion greatly magnified.

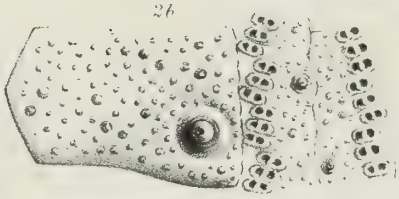
8. Spine of Cidaris.

1a

1b

2c


2a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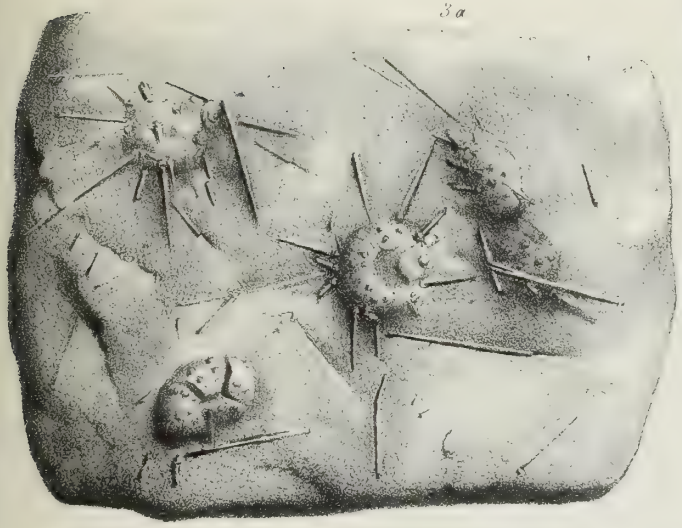
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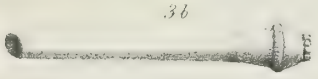
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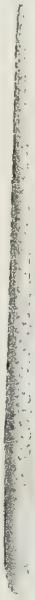
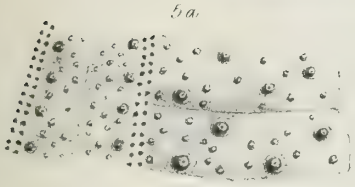
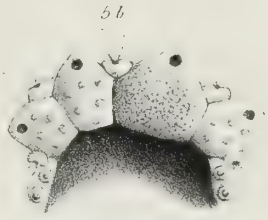
6

7

8




5a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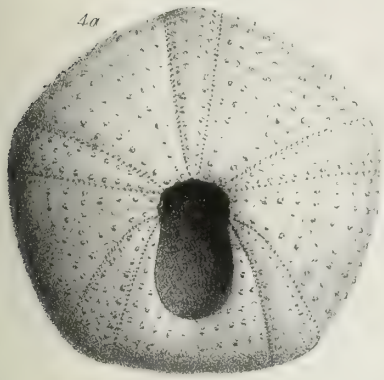
4a

4c

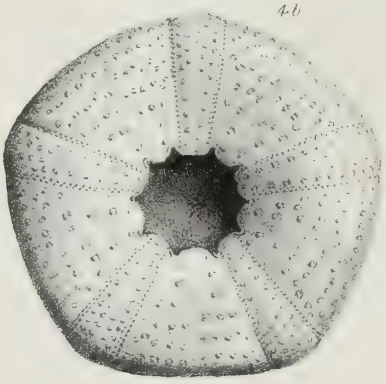
4b

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PLATE XLII.

1 *a*. CIDARIS FOWLERI, *Wright*, p. 32. Test, with spines attached, of the natural size.

b. Inter-ambulacral plate, zones, and ambulacral area, magnified.

c. Primary tubercle, magnified.

d. One of the jaws, magnified.

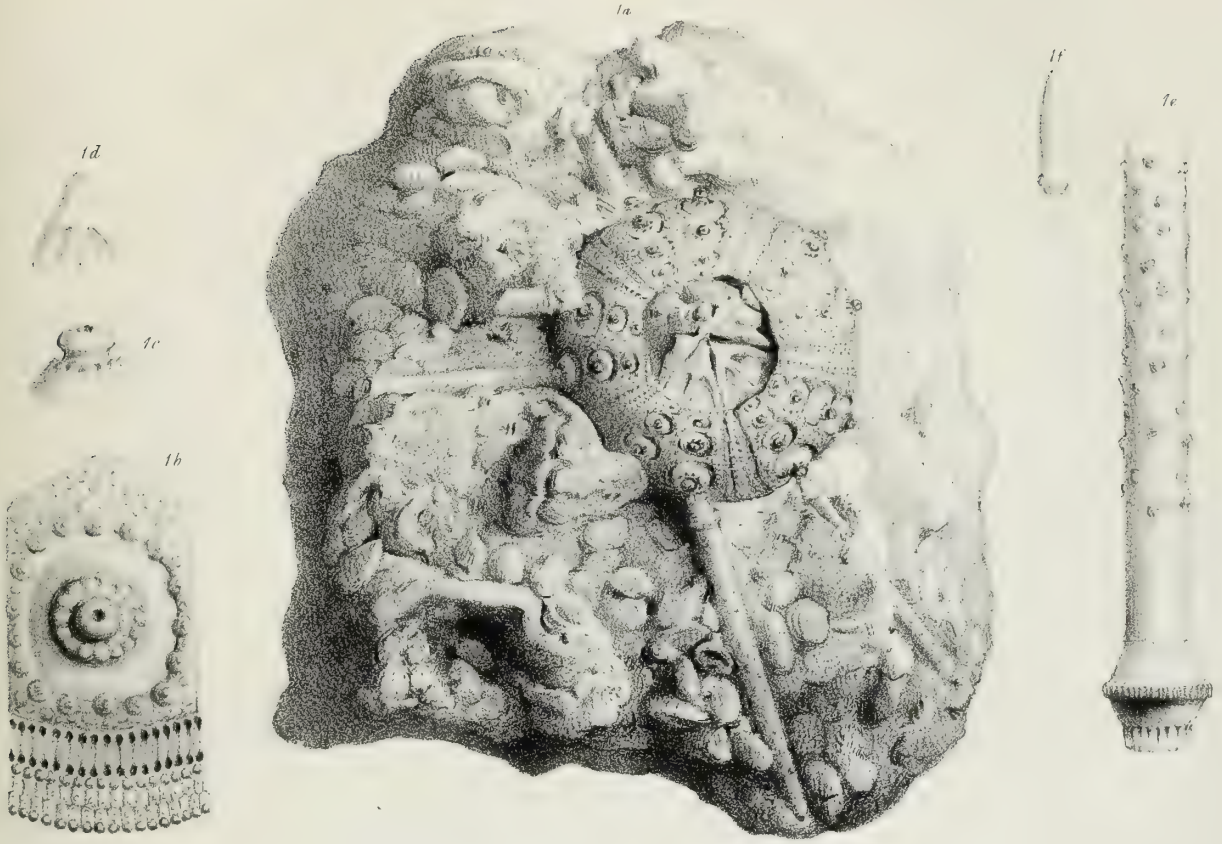
e. One of the primary spines, magnified twice.

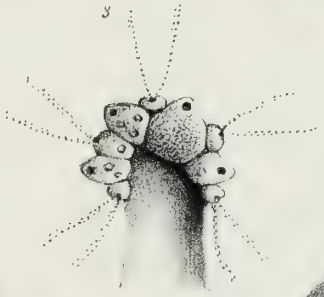
f. One of the secondary spines, magnified three times.

2 *a*. HYBOCLYPUS AGARICIFORMIS, *Forbes*. Upper surface, natural size, showing the apical disc *in situ*.

b. Under surface of the same, natural size.

3. The apical disc of the same urchin, magnified twice.





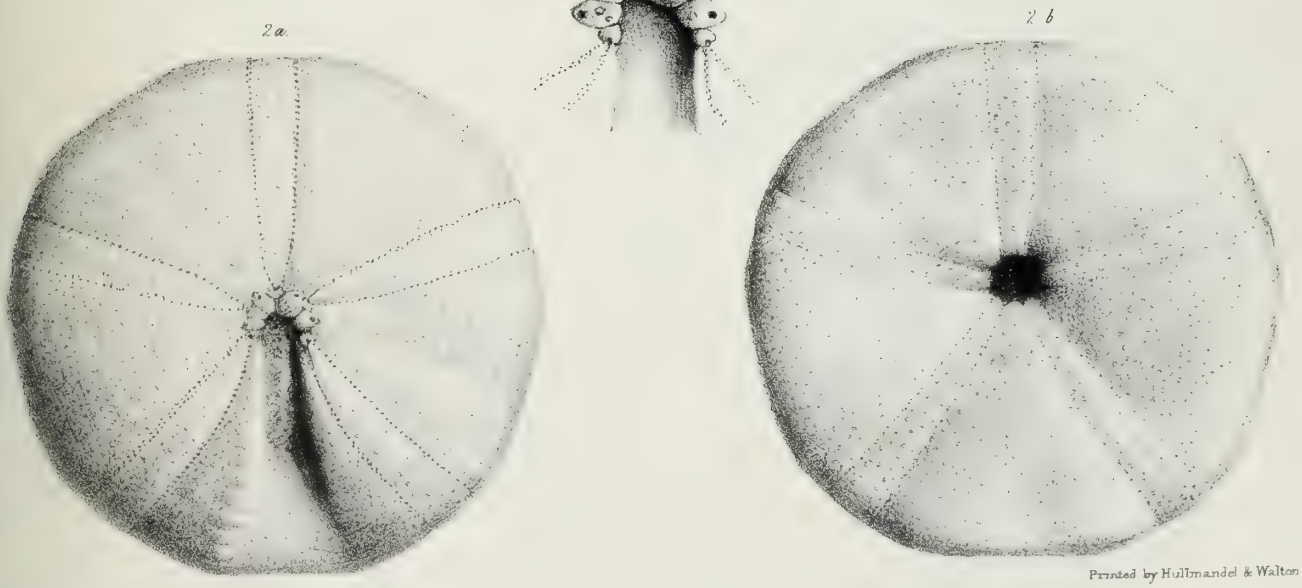


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PLATE XLIII.

1 *a*. Pedina Smithii, *Forbes*, p. 176. Upper surface, natural size.

b. Under surface, natural size, showing the mouth-opening.

c. Lateral view of the same test, natural size.

d. Base of an ambulacral area, showing the crowding of the pores in the zones, magnified four diameters.

2 *a*. Hemicidaris Brillensis, *Wright* (Supplement). Upper surface, natural size.

b. Lateral view of the same test, natural size.

c. Two inter-ambulacral plates, a portion of the ambulacral area, and two poriferous zones, magnified three and a half times.

d. Apical disc, magnified two diameters.

3. Echinobrissus Brodiei, *Wright*, p. 353. Upper surface, natural size.

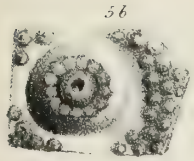
4. *a*. Clypeus Plotii, *Klein*, p. 361. A weathered portion of the upper surface of a test of this species, showing perforated tubercles on all the inter-ambulacral and ambulacral plates, with the madreporiform body extending over all the pieces of the apical disc, magnified three diameters.

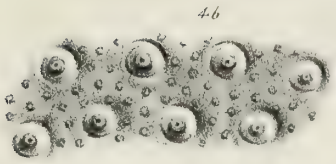
b. Clypeus Plotii, *Klein*, a portion of the upper surface of the test, highly magnified, to show the perforations of the tubercles.

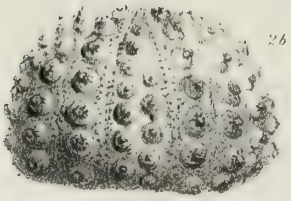
5 *a*. Heterocidaris Wickense, *Wright* (Supplement). Four rows of plates, natural size.

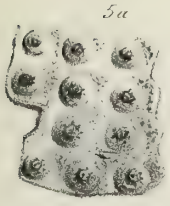
b. One of the plates and primary tubercles, magnified three times.

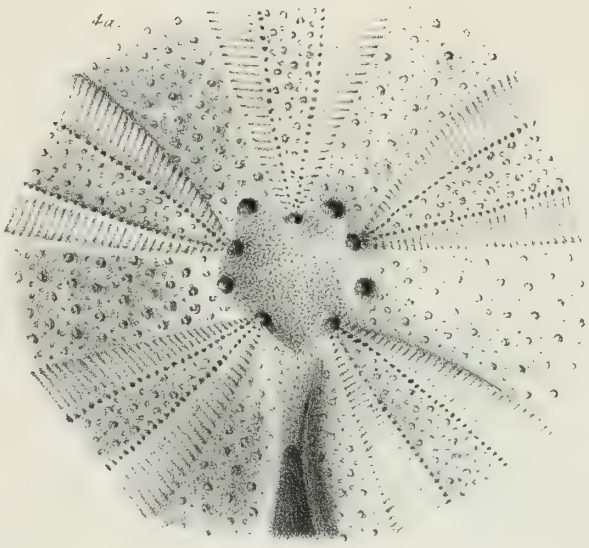
c. A lateral view of one of the primary tubercles, highly magnified.

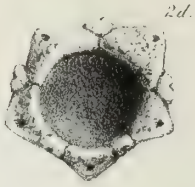


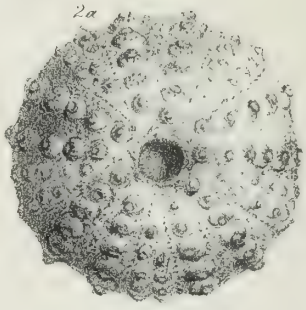


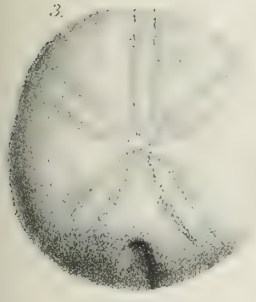


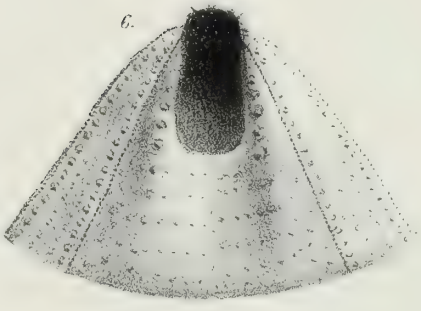


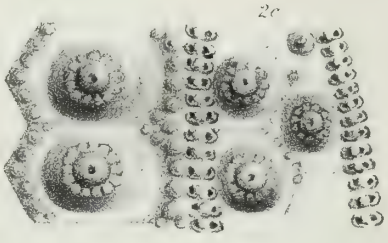


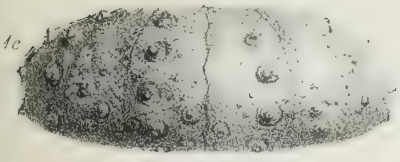


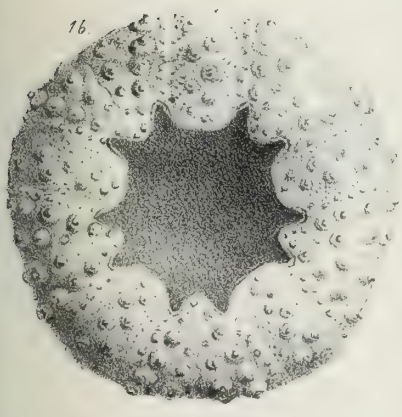


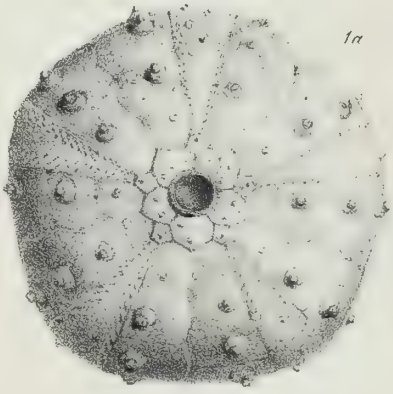












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THE

PALÆONTOGRAPHICAL SOCIETY.

INSTITUTED MDCCCXLVII.

ISSUED FOR 1858.

LONDON:

MDCCCLX.

A MONOGRAPH

OF

THE EOCENE MOLLUSCA,

OR

DESCRIPTIONS OF SHELLS FROM THE OLDER TERTIARIES OF ENGLAND.

BY

FREDERIC E. EDWARDS.

PART III, No. III.

PROSOBRANCHIATA

(CONTINUED).

LONDON:

PRINTED FOR THE PALÆONTOGRAPHICAL SOCIETY.

1860.

PRINTED BY J. E. ADLARD, BARTHOLOMEW CLOSE.

No. 162. Pleurotoma innexa. *Solander*. Tab. XXVIII, fig. 1, *a*—*c*.

Murex innexus. *Sol.* 1766. Brand. Foss. Hant., p. 19, fig. 30.
Pleurotoma innexa. *Forbes*. 1856. Tert. Fluv. Mar. Format., &c.; Mem. Geol. Surv., p. 154, t. 5, fig. 5.

P. testâ elongato-fusiformi, reticulato-crenulatâ: spirâ sub-conicâ, elevatâ: anfractibus vix convexis, lineas elevatas concentricas, et costellas longitudinales, sese decussantes, gerentibus; marginibus posticis angustis, spiraliter sulcatis, ad suturam granulatis; ultimo anfractu in canali patulo, per-brevi, exeunti; costellis acutis, usque ad basin tendentibus, arcuatis, tuberculatis: aperturâ oblongo-ovali, angustâ; labro aliforme, intûs nonnunquam obscure denticulato; sinu lato, rotundato, in margine collocato; labio angusto, incrassato.

Shell elongated, fusiform, and ornamented with concentric and longitudinal raised lines, nearly equally prominent, and which, from their decussation, present the appearance of fine network. The spire is thick, nearly conical, and much elevated, almost equalling two thirds of the entire length of the shell. The whorls, eight or nine, exclusive of a pointed pullus of three volutions, are short, very slightly convex, nearly flat-sided; the posterior margins are very narrow, and present a more or less shallow transverse furrow; they are thickened on the edge of the suture, which is bordered by a single row of small, round, or somewhat oblong, granulations. The longitudinal ribs, which are narrow and sharp, extend from the marginal granulations to the very front of the whorl, and are rather strongly curved over the middle; in general the ribs are a little more prominent than the concentric lines, and are thickened at the points of decussation, like the knots of a net, forming rows of small tubercles, the last of which, immediately in front of the margin, is more prominent than the rest. The concentric lines are irregular, close-set at the base, distant over the front of the whorl, and become more or less crowded as they approach the posterior margin. The aperture is of a narrow, oblong-ovate form, and terminates in a short, wide canal, rather deeply notched in front; the outer lip is much arched, sharp at the edge, thickened within, and presents three or four thick, tooth-like callosities, of which the posterior one in front of the sinus is large and prominent; the inner lip is narrow and thickened; the columella is slightly curved, and bears in front a small crest; the sinus is rounded and wide, occupying the whole width of the margin.

The figure of this shell, given by Brander, is not executed with the felicity which usually characterises that author's work, and to this circumstance, probably, is to be attributed the difficulty which the Continental writers have had in identifying the species. Thus Lamarck and, after him, Deshayes, referred *P. innexa*, although with doubt, to *P. undata* (Lamk.), from which species, however, it is easily distinguished

by the narrower form of the shell, the more conical spire, the reticulated character of the ornamentation, the narrower margin of the whorls, and the shape of the sinus. Again, M. Nyst, with equal hesitation, has suggested the identity of *P. innexa* with his *P. Stoffelsii;* the latter shell, however, differs in the more pointed spire, the greater length of the whorl, the absence of the longitudinal lineation, and the position of the sinus, which, judging from the figure given by the author, is on the shoulder of the whorl. To *P. dubia* (Def.), a species from the Calcaire grossier, *P. innexa* presents a very close resemblance; but the French shell is much smaller, the spire less obtuse, the costellæ fewer, more prominent in character, bifurcated and not decussated, and the transverse lineation is comparatively feeble. I am indebted to M. Deshayes for some specimens of a species from Damery, hitherto undescribed, which appears to be smaller and narrower than the present species, but in other respects to agree closely with it. A comparison of *P. innexa* with a larger series of the Damery shells will probably establish the identity.

Size.—Axis, 9-12ths of an inch; diameter, 3-12ths of an inch.

Localities.—Highcliff, Barton, Alum Bay (Stratum No. 29, Prestwich), Colwell Bay, Bracklesham Bay, and Whitecliff Bay (fide Forbes).*

No. 163. PLEUROTOMA INFLEXA. *Lamk.* Tab. XXVIII, fig. 3, *a—c.*

PLEUROTOMA INFLEXA. *Lamk.* 1804. Ann. du Musée, vol. iii, p. 267, No. 22.
— SEMICOLON. *Sow.* 1816. Min. Con., vol. ii, p. 104, t. 146, fig. 6.
— INFLEXA. *Lamk.* 1822. Hist. nat., &c., vol. vii, p. 101, No. 27.
— — *Desh.* 1824-37. Coq. foss., &c., de Paris, vol. ii, p. 475, t. 66, figs. 11—13.
— — *Bronn.* 1849. Index Palæontol., p. 1005.
— SEMICOLON. *Bronn.* 1849. Idem, p. 1009.
— INFLEXA. *D'Orb.* 1850. Prod. de Paléont., vol. ii, p. 357, No. 359.
— SEMICOLON. *D'Orb.* 1850. Idem, p. 359, No. 423.
— INFLEXA. *Sow.* 1850. Dixon's Geol., &c., of Sussex, p. 103.
— DUBIA? *Defr.* 1824-37. Desh., Coq. foss., &c., de Paris, vol. ii, p. 481, t. 67, figs. 12—14.
Nec — SEMICOLON. *Nyst.* 1836. Coq. foss. de Hoesselt, &c., p. 32, No. 84.
nec — — *Nyst.* 1843. Coq., &c., de Belgique, p. 527, No. 451.
nec — — *S. Wood.* 1848. Crag. Moll., p. 54, t. 6, fig. 3, *a*, *b*.

P. testâ fusiformi, sub-turritâ, costellatâ, transversim obsolete lineatâ: anfractibus numerosis, angustis, sub-planis, ad suturam crenulatis; costellis in medio inflexis, sæpissime

* I suspect that specimens of *P. inflexa* (Lamk.), a form belonging to the Bracklesham Bay series of deposits, have been erroneously referred to *P. innexa*, which that species much resembles. I do not know of any specimen of *P. innexa* coming either from Bracklesham Bay, or from Stubbington, Bramshaw, or Brook.

bifurcatis; ultimo anfractu brevi, ad basin tenuissime striato: aperturâ ovali, in canali brevi, mediocriter lato, exeunti; labro tenuissimo, intûs plicato; sinu lato, minime profundo, sub-semicirculari, in margine collocato.

Shell elongated, narrow, ribbed, and spirally lined: spire elevated, formed of eight or nine volutions exclusive of the pullus: whorls slightly convex, short, and thickened at the sutural margin, which is ornamented with a single row of bold, roundish or oblong beads, imparting somewhat of a turreted character to the spire. The surface of the whorls presents numerous costellæ, long, narrow, curved, swelled at the top, and corresponding with the marginal granulations, so as to resemble a semicolon, from which circumstance the name given by Sowerby was taken; the costellæ, as they pass over the centre of the whorl, bifurcate and disappear towards the base of the shell: the concentric lines are not very prominent, but are most conspicuous on the anterior part of the shell, becoming feeble as they ascend the whorl; they become almost obsolete in the adult shell. The aperture is ovate, one third of the whole length of the shell, and terminates in a short, moderately wide canal; the outer lip is slightly arched, very thin, and plicated within; the sinus is wide, shallow, nearly semicircular, and placed in the margin.

This species presents a very close resemblance to *P. innexa*, of which many may perhaps be inclined to regard it as a local variety. The shell, however, is narrower; the spire more slender; the sutural granulations and the extremities of the costellæ closely approximated instead of being separated by a wide, well defined furrow; the costellæ themselves bifurcated, and the transverse lineation closer and less prominent than in *P. innexa*.

It is difficult to distinguish *P. dubia* (Def.) from the present species. In Defrance's species the longitudinal ribs are fewer and rounder; but the ornamentation of the two appears to be similar in the essential characters, and I should have regarded the two species as identical. M. Deshayes, however, with the advantage of an extended comparison, has considered *P. dubia* as distinct, an opinion in which both Bronn and D'Orbigny concur, and I have therefore cited Defrance's species with a doubt as to the identification.

Nyst has referred some shells from Vliermael to *P. semicolon* (Sow.), which are described as granulated, angulated at the shoulders, and concentrically striated, but not as being costellated; these shells cannot, therefore, be considered as correctly identified.

The Crag Pleurotomæ, referred by Mr. S. Wood, doubtingly, to this species, appear to be distinct; they are both broader shells, with angulated and strongly tuberculated whorls, the posterior margins of which are wide and broadly concave; and the costæ, which in the present species form a prominent character, appear to be obscure or wanting; while, on the other hand, the transverse lineation, which in *P. inflexa* is a subordinate character, is in the Crag shells strong and distinct;

the sinus also is placed on the shoulder. The variety (fig. 3, *a*) somewhat resembles the *P. denticula* of Basterot, and the other shell (fig. 3, *b*) more nearly approaches the typical form of *P. plebeia*. Mr. Wood speaks of *P. semicolon* (Sow.) as being a common and well-known Barton shell; but I have never seen a specimen from that locality. The species appears to be limited to the Bracklesham Bay sands and the synchronous beds; it is rare.

Size.—Axis, 7-12ths of an inch (15 millim.); diameter, 2·3-12ths of an inch (5 millim.).

Localities.—Bracklesham Bay, Stubbington, Bramshaw, Brook. *French:* Grignon, Mouchy (fide Desh.), Les Groux, Hermes, Cuisse-Lamotte, Ver, Acy-en-Mulcien (fide Graves).

No. 164. Pleurotoma lepta. *F. E. Edwards.* Tab. XXVIII, fig. 10, *a*—*c*.

P. testâ parvâ, fusiformi, gracili, spiraliter lineatâ, semi-costellatâ: spirâ elevatâ: anfractibus depresso-convexis, ad humeros angulatis; postice unico sulco profunde exaratis, ad suturam granulato-marginatis; lineis spiralibus elevatis, acutis, haud distantibus; costellis crebris, per-brevibus: aperturâ angusto-ovali, antice in canali brevi, indistincto, terminanti; sinu lato, semicirculari, in margine collocato.

A small, slender, fusiform shell, spirally lined, and ribbed: the spire narrow, pointed, elevated, forming nearly two thirds of the whole length of the shell: the whorls flatly convex, angulated at the shoulders; the posterior margins furrowed by a deep sulcus, and somewhat thickened and granulated round the suture; the concentric lines elevated, sharp, and moderately close; the longitudinal ribs rather numerous, very short, not extending beyond the middle of the whorls, narrow, and slightly oblique. The aperture is narrow, oval, terminating anteriorly in a wide, short, indistinct canal; and the sinus, which is wide and semicircular, is placed in the margin.

This species is closely allied to *P. inflexa*, but the shell is slenderer, with a more broadly furrowed posterior margin; the costellæ also are shorter, the transverse lineation more prominent, and the sinus wider and more rounded.

Size.—Axis, rather more than 3-12ths of an inch; diameter, rather more than 1-12th of an inch.

Localities.—Stubbington and Bracklesham Bay, at both of which places it is rare.

No. 165. Pleurotoma coarctata. *F. E. Edwards.* Tab. XXVIII, fig. 12, *a—c.*

P. testâ sub-fusiformi, costellatâ, concentrice lineatâ: spirâ elevatâ, conoideâ: anfractibus convexiusculis, antice valde coarctatis; postice unico sulco exaratis, ad suturam tuberculatis; costellis arcuatis, per-brevibus; aperturâ ovali, in canali brevi, latiusculo, exeunti; labro arcuato, intûs dentato; sinu sub-trigono, profundo, in margine collocato.

Shell elongate, fusiform, ornamented with longitudinal ribs and sharp, concentric, raised lines: the spire, which is composed of seven or eight whorls, is rather conical, pointed, and elevated, forming almost two thirds of the whole length of the shell. The whorls are slightly convex, and suddenly much contracted towards the middle, so as to be almost angulated; a deep concentric furrow runs round the posterior margin, the sutural edge of which is thickened and presents a single row of round or oblong tubercles, varying in size in different specimens: the ribs are arched, sharp, and rarely extend beyond the middle of the whorl. The aperture is oval and terminates anteriorly in a short, wide canal; the outer lip is arched, sharp-edged, and armed within with two or three teeth, the largest of which is placed immediately in front of the sinus; the sinus itself is deep, sub-trigonal, and wide, occupying the whole breadth of the margin.

This Pleurotoma is smaller and narrower than *P. innexa*, to which it bears some resemblance; but the contracted whorls and short ribs distinguish it from that species.

Size.—Axis, rather more than 5-12ths of an inch; diameter, 2-12ths of an inch.

Locality.—Highcliff, where it is not uncommon.

No. 166. Pleurotoma microcheila. *F. E. Edwards.* Tab. XXVIII, fig. 8, *a—f.*

P. testâ parvâ, crassâ, fusiformi, nodulosâ: spirâ obtusâ: anfractibus convexiusculis, ad humeros sub-angulatis; marginibus posticis canaliculatis, ad suturam unicâ serie tuberculorum ornatis; ultimo anfractu costellas angustas et lineas concentricas acutas, sese decussantes, gerenti: aperturâ elongato-ovali, in canali per-brevi terminanti; labro leviter arcuato, acuto, intûs incrassato, plicifero; sinu lato, sub-profundo, sub-trigono, anticâ in margine collocato.

Var. producta, *testâ angustiori; spirâ elevatiori; lineis spiralibus eminentioribus.*

Shell small, thick, fusiform, and having the whole surface ornamented with concentric rows of round, knob-like tubercles: the spire, which equals the last whorl in length, is obtuse and pointed: the whorls, six or seven in number, exclusive of the

pullus, are slightly convex and angulated at the shoulders ; the posterior margins rather wide, deeply channelled, and bordered by a series of closely-set, knob-like tubercles ; the shoulders present a single row of oblong tubercles, divided by a concentric sulcus, and from these tubercles arise narrow, curved costellæ, which extend almost to the very front of the whorl, and are decussated by sharp, concentric, raised lines, not quite so prominent as the costellæ, forming small tubercles at the points of decussation ; the costellæ and concentric lines, in the earlier whorls, are nearly concealed by the succeeding whorl, and are only perfectly seen on the body-whorl. The aperture is of an oblong-oval form, terminating in a wide, short canal ; the outer lip is but slightly arched, sharp on the edge, and thickened and strongly plicated within ; the sinus, which is placed in front of the margin, is wide, rather deep, and sub-trigonal in shape. A variety occurs in which the shell is narrower, the spire relatively longer, and the concentric lines more prominent.

This seems to be a well-marked species, of which I have not been able to find a foreign representative.

Size.—Axis, 4-12ths of an inch ; diameter, 2-12ths of an inch.

Localities.—Highcliff, where it is found rather abundantly, Alum Bay (No. 29, Prestwich), Barton.

No. 167. Pleurotoma dissimilis. *F. E. Edwards.* Tab. XXVIII, fig. 7, *a—c.*

P. testâ parvâ, crassâ, rugose costatâ, omnino concentrice lineatâ : spirâ brevi, obtusâ, nodulosâ : anfractibus convexiusculis, ad humeros sub-carinatis, postice sulco profundo spiraliter exaratis, marginatis ; costis brevibus, latis, rotundatis ; lineis concentricis plus minusve numerosis, per-elevatis, denticulatis : aperturâ oblongo-ovali, in canali brevi, latiusculo exeunti ; labro sub-recto, acuto, intus unicam plicam dentiformem gerenti ; labio angustissimo ; sinu lato, profundo, trigono, in margine collocato.

Shell small, thick, coarsely ribbed, concentrically lined : the spire wide and rather short, being less than two fifths of the whole length of the shell : the whorls rather convex, slightly carinated at the shoulders, and bordered round the sutural margin by a sharp, elevated, ridge-like line, the space between which and the shoulder is traversed by a deep, round furrow, in which two or three feeble concentric lines are seen. The ribs are few in number, very short, broad, rounded, and separated by narrow furrows ; they become nearly obsolete, and frequently altogether lost on the last whorl ; the concentric lines are sharp, much elevated, more or less numerous in different specimens, and generally denticulated by the lines of growth. The broad, short, posterior terminations of the ribs, left exposed by the overlapping of the succeeding whorls, resemble tubercles, and give a coarsely nodulous character to

the spire. The aperture is of an oblong-ovate form, and terminates anteriorly in a short, but distinct and moderately wide, canal; the outer lip is very slightly arched, nearly straight, sharp-edged, and presents within, near the posterior extremity, and immediately under the shoulder, a single large, tooth-shaped callosity; the inner lip is very narrow, barely extending to the front of the columella; the sinus is nearly triangular in form, deep and wide, extending across the whole of the posterior margin.

Size.—Axis, 3·4-12ths of an inch; diameter, 1·75-12ths of an inch.

Localities.—Highcliff, where it is not uncommon; Haverstock Hill.

No. 168. Pleurotoma gomphoidea. *F. E. Edwards.* Tab. XXVIII, fig. 13, *a—f.*

P. testâ angustâ, elongatâ, sub-turritâ, longitudinaliter costatâ, concentrice lineatâ: spirâ acuminatâ, elevatâ: anfractibus depresso-convexis, ad humeros sub-angulatis; marginibus posticis latiusculis, concavis, ad suturam distanter granulatis; ultimo anfractu brevi, antice coarctato; costellis curvis, brevibus, plus minusve numerosis; lineis concentricis, supra margines fere obsoletis, cæterum elevatis, acutis, sæpe denticulatis: aperturâ oblongo-ovali, in canali brevi, sub-recto exeunti; labro sub-aliformi, acuto, sinu lato, minime profundo, in margine collocato.

Var. avita, *testâ anfractibus unicâ serie tuberculorum coronatis.*

A long, narrow, turriculate shell, ribbed, and concentrically lined: the spire, which forms two thirds of the whole shell, consists of seven or eight volutions: the whorls are flatly convex on the sides, angulated at the shoulders, contracting rather suddenly in front, and having the posterior margins widely channelled and bordered on the sutural edge by a single row of round, rather distant granules, corresponding with the ribs, and variable in size; the angulated shoulders and channelled margins give a turriculate character to the spire. The longitudinal ribs are more or less numerous in different specimens; they are curved, sharp, and terminate abruptly where the whorl contracts; the concentric lines over the posterior margins are close-set, and so fine as to be barely visible to the naked eye; over the middle and front parts of the whorl they are moderately distant, elevated, sharp, and generally denticulated where they cross the ribs. The aperture is of an oblong-oval shape, and terminates in a wide, short, but distinct and nearly straight canal; the outer lip is expanded anteriorly, sharp-edged, and smooth within; and the sinus, which is wide, rather shallow, and rounded, is placed in the margin.

I possess specimens both from Clarendon and Southampton, in which the ribs are wanting, and the whorls are girt round the shoulders with a single row of knob-like tubercles; in all other respects these shells agree with the typical *P. gomphoidea*, of which, therefore, I consider them to be a variety.

Size.—Axis, rather less than half an inch; diameter, not quite 2-12ths of an inch.

Localities.—Barton, Highcliff, Alum Bay (No. 29, Prestwich). *For the variety:* Clarendon and Southampton.

No. 169. Pleurotoma plicata. *Lamk.* Tab. XXVIII, fig. 11, *a—c.*

Pleurotoma plicata.	*Lamk.*	1804. Ann. du Mus., vol. iii, p. 169, No. 14.
—	—	*Lamk.* 1822. Hist. natur., &c., vol. vii, p. 100, No. 19.
	—	*Desh.* 1824-37. Descr. des Coq. foss., &c., vol. ii, p. 487, t. 66, figs. 17—19.
Nec —	—	*Bast.* 1825. Mem. Géol. sur les Env. de Bord., p. 64, No. 6.
nec —	—	*Des Moul.* 1834. (Dufrén. Terr. tert., &c., du Midi de la France.) Ann. des Mines, 3d series, vol. iii, p. 122.
nec —	—	*Phil.* 1836. Enum. Moll. Sicil., p. 198, No. 5.
nec —	—	*Grat.* 1847. Conchyl. foss., &c., du bass. de l'Adour (Atlas); Pleurot., t. 2, No. 20, fig. 36.

P. testâ crassâ, elongato-fusiformi, angustâ, longitudinaliter costatâ, omnino concentrice lineatâ: spirâ mediocriter elatâ, sub-acuminatâ: anfractibus convexis, suturâ perspicuâ divisis; costis rotundatis, obliquis, arcuatis, distantibus; lineis concentricis filiformibus, regularibus: aperturâ angustâ, ovali, in canali brevi exeunti; labro acuto, intus incrassato postice, prope sinum, callum nodiformem gerente; sinu lato, profundo, sub-trigono, in margine collocato.

Shell thick, elongated, fusiform, rather narrow, longitudinally ribbed, and having the whole surface covered with concentric, raised lines; the spire, which consists of six or seven volutions, exclusive of the pullus, is moderately elevated, forming nearly one half of the whole length of the shell; the whorls convex, and separated by a perspicuous suture. The longitudinal ribs are prominent, rounded, oblique, slightly curved, distant, numbering only six or seven on each whorl, and becoming nearly obsolete on the body-whorl; the intermediate spaces are nearly flat, imparting a polygonal aspect to the spire; the concentric lines are rather numerous, elevated, rounded, clearly defined, and regular, giving to the shell the appearance of being bound with thread; the two or three lines over the shoulder are, in general, more distant, and a very little more prominent, than the others. The aperture is of a narrow, oval form, and terminates in a wide, short canal; the outer lip is moderately arched, sharp on the edge, much thickened within, where it presents a long, rather broad, and elevated ridge, extending quite into the canal, and terminating behind, immediately in front of the sinus, in a round, knob-like callus; the sinus is broad, deep, somewhat triangular in shape, and placed in the margin.

The English shells present several points of disagreement with those from the

Calcaire grossier, and may be regarded by some, perhaps not unreasonably, as specifically distinct rather than as constituting a local variety. Thus, in the French shells, the posterior margins of the whorls are so feebly lined that to the naked eye they appear to be smooth ; the ribs are more numerous, narrower, and less prominent ; the concentric lines are rather more crowded and more feeble, becoming nearly obsolete ; and the shells themselves are thinner. It appears to me, however, that these variations can scarcely be regarded as of specific value ; while in the relative proportions, the general character of the ornamentation, the condition of the outer lip, particularly the characteristic callus, and the shape and position of the sinus, the French and English shells correspond. On the whole, therefore, I am inclined to regard the English shells as forming merely a coarse, strongly marked variety of the French species.

The shells from Dax and Bordeaux, referred to this species by Basterot and Grateloup, appear to be distinct, and Desmoulins has separated them under the name *P. variabilis*. According to Bronn, they correspond with certain Pleurotomoid shells previously separated by Millet as *Defrancia variabilis*.

Size.—Axis, 8-12ths of an inch (17 millim.); diameter, 3-12ths of an inch ($6\frac{1}{2}$ millim.)

Localities.—Bramshaw, Brook. *French:* Grignon, Parnes, Mouchy, Courtagnon (fide Desh.), Halaincourt (fide Graves).

No. 170. Pleurotoma acuticosta. *Nyst.?* Tab. XXVIII, fig. 14, *a—c*.

Pleurotoma acuticosta. *Nyst.?* 1843. Coq., &c., foss. de Belg., p. 529, No. 454, tab. 42, fig. 5.
— — *Morris.* 1854. Cat. Brit. Foss., 2d edit., p. 269.

P. testâ elongato-fusiformi, longitudinaliter costellatâ, concentrice lineatâ : spirâ elevatâ, acuminatâ : anfractibus convexiusculis, postice depressis, sub-canaliculatis ; ultimo anfractu antice coarctato, in canali brevi, indistincto, latiusculo terminanti ; costellis obliquis, angustis, sub-distantibus ; lineis concentricis exilibus, numerosis : aperturâ ovatâ ; labro leviter arcuato acuto ; sinu lato, sub-semicirculari, in margine collocato.

Shell oblong, fusiform, longitudinally ribbed, concentrically lined ; spire pointed, much produced, nearly equalling three fifths of the entire length of the shell ; whorls, eight or nine, slightly convex ; the posterior margins somewhat depressed and furrowed ; the last whorl contracted in front and forming a wide, short, and indistinct canal. The longitudinal ribs are narrow, rather distant, rounded on the upper surface, and slightly oblique ; the concentric lines very slender, irregular, close-set, becoming obsolete over the posterior margins. The aperture is of an oblong-oval

form; the outer lip a little arched, thin, sharp-edged, and smooth within; the sinus wide and nearly semicircular, and placed in the posterior margin.

The figure of *P. acuticosta* in M. Nyst's work is, unfortunately, so indistinct that it affords but little assistance towards an identification. The English shell, however, agrees tolerably well with the description given by that author, and I have referred it to M. Nyst's species, although with hesitation, as I have not had an opportunity of comparing it with any Belgian specimen.

The English shells which the present Pleurotoma most nearly resembles, are those referred to *P. plicata* (Lamk.); but this species differs from them in the more slender form of the shell, the more depressed margins of the whorls, the narrower, more numerous, and more regular costæ, and the finer transverse lineation; and, in the specimen I possess, the outer lip is not thickened within, nor does it present the callus which characterises *P. plicata*.

The species appears to be very rare.

Size.—Axis, $\frac{1}{2}$ inch; diameter, rather more than 2-12ths of an inch.

Localities.—Barton. *Belgian:* Gremittingen (Lower Limburg series).

No. 171. PLEUROTOMA TERETICOSTA. *F. E. Edwards.* Tab. XXIX, fig. 5, *a—d.*

P. testâ fusiformi, sub-turritâ, costellatâ, spiraliter fasciolatâ: spirâ obtusiusculâ, elevatâ, in longitudine aperturam æquanti: anfractibus depresso-convexis, ad humeros sub-angulatis, postice sulco profundo exaratis, marginatis; ultimo anfractu antice coarctato, in canalem brevem latum producto; costellis numerosis, leviter arcuatis, rotundatis, brevibus; fasciolis spiralibus crebris, irregularibus, alternatim latiusculis et angustioribus; fasciolis anterioribus elevatis, cæteris fere obsoletis: sinu lato, minime profundo, triangulari, in margine collocato.

Var. SOROR, *testâ spiraliter sulcatâ; canali antico breviori.*

Shell fusiform, longitudinally ribbed, and spirally girt with ribbon-like bands: the spire is thickish and moderately elevated, not exceeding the aperture in length: the whorls, five or six in number without the pullus, are rather flat-sided and bluntly angulated at the shoulders; the posterior margins narrow, deeply furrowed, and much thickened at the edges, where they present a moderately wide band running round the suture. The longitudinal ribs are numerous (twelve to fourteen), slightly curved, round and smooth on the upper surface, short, not extending beyond the middle of the whorl, tapering towards the front, and occasionally bifurcated; the posterior extremities are continued over the shoulder up to the sutural band; the spiral bands are numerous and irregular, ribbon-like bands alternating with other narrower bands; over the anterior canal and the front part of the whorl up to the termination of the ribs, these bands are elevated and distinct; elsewhere they are nearly obsolete. The body-whorl contracts rather suddenly about the middle,

and thence tapers gradually towards the front, so as to form a wide and short, but distinct, canal; the aperture is of a compressed-oval shape; and the sinus, which is placed in the marginal furrow, is wide, shallow, and triangular in form.

The general resemblance between the present species and *P. turgidula* might suggest the propriety of uniting the two; but, on a careful examination, differences will be found which seem to justify their separation. Thus, in the present species, the spire is more obtuse; the whorls more contracted in front; the posterior margins deeply furrowed and bordered at the suture by a broad, thick band; the longitudinal ribs are more numerous, more decided in character, and less oblique; and the sinus is shallower and more pointed.

A specimen in my cabinet, obtained from the Artesian well at Southampton, has the surface of the shell spirally furrowed instead of banded, and the anterior canal a little shorter and wider. These differences, however, do not appear to be sufficiently important for specific distinction, and I have therefore regarded the shell in question as a variety of the present species.

Size.—Axis, 6-12ths of an inch; diameter, rather more than 2-12ths of an inch.

Localities.—Highgate, Southampton.

No. 172. Pleurotoma turgidula. *F. E. Edwards.* Tab. XXIX, fig. 4, *a—c.*

P. testâ fusiformi, sub-turritâ, spiraliter sulcatâ, costellatâ: anfractibus sub-ventricosis, ad humeros angulatis, postice declivis vix cavatis, ad suturas unicâ serie granularum instructis; sulcis spiralibus irregularibus, minime profundis, fere obsoletis; costellis obliquis, angustis: aperturâ ovali, antice in canali breviusculo exeunti; labro arcuato; sinu sub-trigono, latiusculo, mediâ in margine collocato.

Shell fusiform, sub-turreted, concentrically furrowed, and longitudinally ribbed; the spire, formed of six volutions exclusive of the pullus, is moderately elevated, forming rather less than half of the shell: the whorls are roundedly convex, almost ventricose, and bluntly angulated at the shoulders; the posterior margins, which slope gently backwards, are nearly straight, and the sutural edge is girt by a single row of small, round tubercles. The concentric furrows are numerous, irregular, and almost obsolete over the posterior margins and middle of the whorls, but a little deeper and more perspicuous over the front; the longitudinal ribs are rather numerous, narrow, oblique, and very short, barely extending to the middle of the whorl, and slightly swelled at the posterior extremities; on the last whorl the ribs become reduced to small and not very prominent tubercles. The aperture is oval, and terminates in front in a short, but distinct and moderately wide, canal; the outer lip is slightly arched; the sinus, placed in the very middle of the posterior margin, is wide, rather shallow, and somewhat triangular in form.

Size.—Axis, 8-12ths of an inch ; diameter, 3-12ths of an inch.
Locality.—Alum Bay (Stratum No. 29, Prestwich?); rare.

No. 173. Pleurotoma dilinum. *F. E. Edwards.* Tab. XXVIII, fig. 15, *a*, *b*.

P. testâ minimâ, oblongâ, fusiformi, granulatâ, concentrice lineatâ: spirâ obtusiusculâ, sub-conicâ: anfractibus sub-convexis, duplici serie granulorum coronatis, spatio inter series concavo, lævi; ultimo anfractu antice valde coarctato, in canalem latissimum, brevem, reflexum producto; lineis spiralibus, acutis, sub-distantibus: aperturâ ovali; labro acuto, leviter arcuato, intûs plicato; sinu latissimo, mediocriter profundo, subtrigono, anticâ in margine collocato.

Shell very small, oblong, fusiform, spirally girt by a double row of small, bead-like tubercles, concentrically lined ; spire rather thick, nearly conical ; whorls slightly convex ; the posterior margins concave, smooth, bordered in front and behind by the rows of tubercles ; the last whorl much contracted in front, and terminating in a very wide, short, but distinct, canal, a little bent backwards ; the concentric lines thin, sharp, and rather distant. The aperture is of an oval form ; the outer lip slightly arched, expanding towards the front, sharp-edged, and plicated within ; the sinus very wide, moderately deep, somewhat triangular in shape, and placed in the front part of the posterior margin.

This Pleurotoma is allied to *P. microcheila*, the var. *producta* of which closely resembles it ; but the wide posterior margins, the greater regularity of the granulations, and the broad anterior canal, distinguish the present species.

Size.—Axis, not quite 3-12ths of an inch ; diameter, 1-12th of an inch.
Locality.—Alum Bay (No. 29, Prestwich).

No. 174. Pleurotoma tricincta. *F. E. Edwards.* Tab. XXVIII, fig. 6, *a*, *b*.

P. testâ parvâ, elongato-fusiformi, sub-turritâ, spiraliter lineatâ: spirâ acuminatâ, breviusculâ, aperturam in longitudine vix æquanti: anfractibus depresso-convexis; postice profunde canaliculatis, marginatis; ultimo anfractu in canalem brevem, latum, producto; lineis spiralibus exilibus, filiformibus, irregularibus, sub-clathratis: aperturâ oblongo-ovali; labro arcuato; sinu lato, mediocriter profundo, in margine collocato.

Shell small, oblong, fusiform, indistinctly turreted, concentrically lined ; spire pointed, rather short, not equalling the last whorl in length ; whorls flatly convex at the sides ; the posterior margins deeply hollowed, giving the turreted aspect to the spire, and ornamented with a series of roundedly curved plications, formed by the successive elevated margins of the sinus ; the sutural edge is bordered by a sharp, ridge-like, raised line ; the last whorl is contracted in front, and terminates in a very

wide, short, indistinct canal. The spiral lines are slender, thread-like and irregular, others, finer still, occasionally intervening; all are much roughened, almost decussated, by the prominent lines of growth; from the upper three lines, left uncovered by the succeeding whorl, the specific name is taken. The aperture is of a narrow, oval form; the outer lip roundedly arched, thin, sharp-edged, and smooth within; and the sinus, which extends over the whole breadth of the margin, is wide, rather deep, and somewhat triangular in form.

The only two specimens I have seen of this rare Pleurotoma do not appear to have attained their full growth; the characters, however, are sufficiently distinct to justify the present notice.

Size.—Axis, 4-12ths of an inch, nearly; diameter, 1-8th of an inch.

Locality.—Potter's Bar.

No. 175. Pleurotoma pupa. *F. E. Edwards.* Tab. XXVIII, fig. 9, *a—c.*

P. testâ elongato-fusiformi, longitudinaliter plicatâ, concentrice lineatâ: spirâ obtusiusculâ, sub-conicâ: anfractibus convexiusculis; postice plicatis, unico sulco angusto exaratis, ad suturam aliquando lineâ elevatâ filiformi cinctis, aliquando granulatis; costellis crebris angustis, arcuatis, in ultimo anfractu obsoletis; lineis concentricis acutis, plus minusve numerosis, costellas decussantibus: aperturâ angustâ, ovali, in canali brevi, obliquo exeunti; labro leviter arcuato, intûs plicato; sinu sub-trigono, profundo, in margine collocato.

Var. **a**, *testâ graciliori; spirâ acutiori.*

Shell oblong, fusiform, with an elevated, somewhat obtuse, and nearly conical spire, forming one half of the entire shell; whorls six or seven, slightly convex, longitudinally plicated, concentrically lined, and separated by a conspicuous suture; the posterior margins are thickened round the sutural edge, and present a narrow, concentric furrow, corresponding with the smaller extremity of the sinus, and finely plicated; the narrow space between this furrow and the suture is girt by a thickish, elevated, thread-like line, generally simple, but sometimes—more especially in the early whorls—decussated by the successive margins of the sinus, so as to present a row of rather coarse granulations. The longitudinal plications are numerous, and curved; they are slightly prominent on the shoulder, but become attenuated as they pass over the middle of the whorl, and are frequently altogether lost on the last whorl of the mature shell. The concentric lines are prominent, sharp, more or less distant in different specimens, and feebly denticulated, where they cross the longitudinal plications. The aperture is of a narrowish, oval form, and terminates in front in a short, but distinct and moderately wide, canal, to which the twisted columella gives an oblique direction; the outer lip is slightly arched, thin, and sharp

on the edge, and frequently, but not invariably, armed within with three or four pliciform teeth ; the sinus is deep, three-cornered, and placed in the margin.

A variety occurs in which the shell is slenderer, and the spire more pointed.

Size.—Axis, 6-12ths of an inch; diameter, rather more than 2-12ths of an inch.

Localities.—Barton, Highcliff, for the type; Bramshaw and Alum Bay (Stratum No. 4, Prestwich), for the variety.

No. 176. Pleurotoma scabriuscula. *F. E. Edwards.* Tab. XXIX, fig. 2, *a—c.*

Pleurotoma decussata, *Lamk.*? 1804. Ann. du Mus., vol. iii, p. 267, No. 25.

P. testâ sub-turritâ, tuberculatâ, omnino concentrice lineatâ : spirâ obtusiusculâ, elatâ, in longitudine dimidium totius testæ superanti : anfractibus convexis, antice coarctatis, ad humeros sub-angulatis, unicâ serie tuberculorum instructis ; marginibus posticis declivis, vix cavatis, granulato-marginatis ; lineis concentricis elevatis, sub-distantibus, simplicibus vel leviter denticulatis : aperturâ obovatâ, in canali lato, brevi terminatâ ; labro arcuato, acuto, intûs plicato ; sinu lato, profundo, sub-trigono, mediâ in margine collocato.

Var. a, testâ tuberculis verticaliter productis, costellas simulantibus.

Shell turriculated, tuberculated, and ornamented with concentric, raised lines, which cover the whole surface: the spire, consisting of six or seven volutions, is rather thick and elevated, forming a little more than one half of the entire shell. The whorls are convex, slightly contracted in front, and bluntly angulated at the shoulders, where they present a single row of small, oblong tubercles, more or less distant in different individuals, and crossed by the concentric lines, two of which are generally more prominent than the rest; the posterior margins are moderately wide, gently depressed, very slightly concave, and thickened and granulated round the sutural edge. The concentric lines are prominent, sharp, and not very distant, varying in this respect in different specimens ; they are generally simple and smooth on the edge, but sometimes denticulated by the strongly marked lines of growth. The aperture is of a broadish, oval shape, and terminates anteriorly in a wide and short, but distinct, canal; the outer lip is much arched, sharp-edged, and plicated within ; the sinus is wide, deep, somewhat triangular in form, and placed in the middle of the margin.

A variety occurs, rather plentifully, in which the spire is more pointed, and the tubercles on the shoulders of the whorls are lengthened both in front and behind, so as to form short, narrow ribs.

This shell presents so close a resemblance to *P. decussata* (Lamk.), that I am reluctant to consider the two as specifically distinct. The French shell is generally narrower, and the body-whorl is less contracted in front and more conical than in the English specimens ; and M. Deshayes describes it as being much shorter than the spire ; but in a series of French specimens, for which I am indebted to the liberality

of that gentleman, the spire forms, in a majority of instances, very little more than half of the length of the shell, and the diameter, in some individuals, is relatively greater than that of the English shells. The tubercles are larger and coarser in the French shells, and the plication within the outer lip is found in them, although that character is not noticed by M. Deshayes.

The chief distinctions between the English and French shells appear to lie in the more conical form of the whorls and the coarser tuberculation in the latter; but these distinctions give very different aspects to the shells, and I have not ventured absolutely to refer the English shells to the French species, although they may perhaps be fairly regarded as forming a local variety.

Size.—Axis, rather more than 5-12ths of an inch (11 millim.); diameter, rather more than 2-12ths of an inch (5 millim.).

Localities.—Highcliff (where it is rather abundant) and Barton.

No. 177. Pleurotoma verticillum. *F. E. Edwards.* Tab. XXIX, fig 3, *a*—*c*.

P. testâ turriculatâ, longitudinaliter costellatâ, omnino concentrice lineatâ: spirâ elatâ, acuminatâ: anfractibus planulatis, ad humeros angulatis, antice coarctatis; marginibus posticis depressis, sub-rectis, vix cavatis, obscure lineatis, ad suturam granulatis; ultimo anfractu in canali brevi terminanti; costellis crebris, arcuatis, acutis, fere ad basin tendentibus; lineis concentricis irregularibus, acutis, denticulatis: aperturâ ovali; labro arcuato, acuto, intûs plicato; sinu profundo, sub-trigono, anticâ in margine collocato.

Var. testâ costellis brevioribus, tuberculiformibus, ultimo anfractu obsoletis.

Shell turriculate, longitudinally ribbed, concentrically lined: spire pointed, elevated, considerably exceeding the aperture in length; whorls, eight or nine, flat-sided, slightly angulated at the shoulders, and much contracted in front; the posterior margins depressed, very slightly channeled, nearly straight, and most generally bordered round the sutural edge by a row of small tubercles. The longitudinal ribs are numerous, thin, sharp, and obliquely curved, and extend almost to the very front of the shell; the concentric lines are elevated and sharp, and cover the whole surface of the shell; over the margins of the whorls they are moderately close and regular; but over the middle and front parts of the whorls they become more elevated, more distant, and somewhat irregular, very fine lines occasionally intervening between the more prominent ones; these concentric lines strongly decussate the longitudinal ribs, rising into small, sharp tubercles at the points of decussation. The aperture is rather widely oval, and terminates anteriorly in a short, but distinct, canal; the outer lip is arched, and somewhat dilated in front; the inner lip narrow, but thick and prominent; and the sinus, which is three-cornered in shape, deep, and wide, is placed in the front part of the margin.

Occasionally specimens occur in which the longitudinal ribs are lost on the last

whorl, and are much shortened on the earlier whorls, assuming the appearance of oblong tubercles; and the decussation by the concentric lines disappears.

The present species presents a close analogy with *P. scabriuscula*, with which it may, especially in the young state, be readily confounded. On comparing adult shells, however, it will be found that, in this species, the shell is wider, the spire more pointed, the whorls less bluntly angulated at the shoulders, and more depressed and more deeply channeled round the margin, giving a decidedly turreted character to the spire; the whorls themselves are more numerous and shorter, and, in the typical form, the sharp ribs and prominent concentric lines give a rougher aspect to the surface. In the varieties a somewhat closer approximation will be found in the ornamentation of the two species; but, in other respects, the characteristic distinctions are preserved.

From *P. constricta*, the only other species with which it might be confounded, it is separated by the depressed margins, and more sharply angulated shoulders of the whorls, the more regular costellation, and the deep, narrow sinus of that species.

Size.—Axis, rather more than 8-12ths of an inch; diameter, 3-12ths of an inch.

Localities.—Barton, Highcliff; not common.

No. 178. Pleurotoma constricta. *F. E. Edwards.* Tab. XXIX, fig. 1, *a—c.*

P. testâ elongato-fusiformi, longitudinaliter costellatâ, concentrice lineatâ: spirâ conoideâ, sub-acuminatâ, aperturam in longitudine paullo superanti: anfractibus depresso-convexis, ultimo anfractu in canali brevi, terminanti; marginibus posticis leviter declivis, canaliculatis, plicatis, ad suturam marginatis; costellis crebris, angustis, obliquis; lineis concentricis, acutis, denticulatis: aperturâ oblongo-ovali; labro leviter arcuato; sinu angusto, profundo, trigono, anticâ in margine collocato.

Shell elongated, fusiform, longitudinally ribbed, and concentrically lined; the spire, formed of seven or eight whorls, is rather conical, pointed, and moderately elevated, barely exceeding the body-whorl in length; whorls flatly convex; the posterior margins widely and deeply channeled, thickened at the sutural edges, and bordered by a single sharp, prominently raised line; the surface of the marginal furrow presents a series of prominent, curved plications, formed by the successive margins of the advancing sinus. The longitudinal ribs are numerous, slender, oblique, slightly curved, and extend almost to the very front of the whorl; the concentric lines are sharp, prominent, more or less distant in different individuals, and denticulated at the points where they cross the ribs. The aperture is of an oblong-oval form, and terminates in front in a short, moderately wide, canal; the outer lip is but slightly arched, thin, sharp-edged, and smooth within; the sinus is trigonal, narrow, very deep, and placed in the front part of the margin.

The present species much resembles *P. innexa*, with which, in fact, at first sight, it may be easily confounded; on a closer inspection, however, differences will be detected which render it impossible to regard it as even a strongly-marked variety of *P. innexa*. In the general form, *P. constricta* is a slenderer shell, with a more pointed spire, and, instead of the shallow, obscure furrow, bordered by a row of granulations which runs round the posterior margins of the whorls in *P. innexa*, the present species presents a wide, conspicuous channel, defined by a sharp, elevated ridge; the outer lip is much less arched, and is not thickened or plicated within, and the sinus is deep, narrow, three-cornered, and placed in the front part of the margin, instead of the wide, rounded sinus extending over the whole width of the margin which characterises *P. innexa*.

Size.—Axis, rather more than 8-12ths of an inch; diameter, 3-12ths of an inch.

Localities.—Barton, Highcliff, Highgate.

No. 179. Pleurotoma pyrgota. *F. E. Edwards.* Tab. XXVIII, fig. 16, *a—c.*

P. testâ sub-fusiformi, turritâ, longitudinaliter obscure costulatâ, concentrice sulcatâ: anfractibus ad humeros carinatis, antice planulatis, sub-conicis, postice canaliculatis, transversim lineatis, crenato-marginatis; costellis antice bifurcatis, sub-obsoletis: aperturâ oblongo-ovali, in canali brevi exeunti; labro intûs plicifero; sinu lato, sub-semicirculari, in margine collocato.

Var. a. *Testâ costellis distinctioribus, productioribus: anfractibus antice granoso-lineatis, cæterûm lævibus.*

Shell sub-fusiform, turreted, longitudinally ribbed, and concentrically furrowed: the spire, which consists of seven or eight volutions, exclusive of the smooth, conical pullus, is moderately elevated, forming about one half of the entire shell; the whorls flat-sided, giving a nearly conical aspect to the anterior part of the shell, sharply carinated at the shoulders, and having the posterior margins channelled and bordered round the suture by a sharp, elevated line, simple or feebly crenulated, the concave space between which and the shoulder is smooth; the keel on the shoulders is notched with much regularity, presenting a row of oblong, somewhat oblique, rib-like tubercles. These tubercles are prolonged anteriorly, and bifurcate, forming two curved, narrow, obscure ribs, which are lost as they cross the middle of the whorls; the concentric furrows are shallow and wide, the intervening spaces becoming gradually more elevated and sharper as they approach the base of the shell. The aperture is of a narrow, elongated, oval form, and terminates in front in a short, wide canal; the outer lip is slightly arched, somewhat thickened and plicated within; and the sinus, which extends over the whole margin, is wide and deep, and nearly semicircular.

Specimens occur, constituting a local variety, in which the ribs are more distant and prominent, and extend to the very front of the shell; four or five distant, elevated, concentric lines cross the whorl over the anterior canal, and are granulated at the points where they are intersected by the lengthened ribs; elsewhere the whorls are smooth.

A miocene shell, described by Brocchi (*Murex reticulatus—Pleur. ramosa*, Bast.), presents a very close analogy with this Pleurotoma, as well in the general shape as in the character of the ornamentation; it is distinguishable, however, by the greater size of the shell, which attains a length of nearly three inches, the greater narrowness and the simple margins of the whorls, the relatively longer spire and shorter aperture, the shape and position of the sinus, and the condition of the outer lip, which is smooth within. A Pleurotoma also occurs in the nummulitic beds near Pau, described by Rouault (*Pleur. Tallavignesii*), to which I have referred some shells from Nuncham and Southend, and which, in the young state particularly, much resembles the present species; but in that shell the whorls are more contracted in front; the posterior margins spirally lined, wider, and not so depressed; the longitudinal plications are more oblique, the lineation finer and more close; the anterior canal longer; the outer lip more arched; and the sinus not so deep.

Size.—Axis, 10-12ths of an inch nearly; diameter, rather more than 3-12ths of an inch.

Localities.—Bramshaw, for the type; Brockenhurst, for the variety.

No. 180. Pleurotoma brevirostrum. *Sow.* Tab. XXIX, fig. 6, *a*, *b*.

	Pleurotoma brevirostrum.		*Sow.* 1823. Min. Con., vol. iv, p. 120, t. 387, fig. 2.
	—	—	*Bronn.* 1848. Index Palæont., p. 1092.
	—	—	*D'Orb.* 1852. Prodrome de Paléont., 25e. Etage, No. 411.
Nec	Pleurotoma brevirostrum.		*Sism.* 1847. Syn. Meth. Anim. Invert. Pedem. foss., p. 32.
nec	—	—	*Bell.* 1847. Pleurot. Foss. del Piem. (Mem. R. Accad. delle Sc. di Torino), p. 607, t. 4, fig. 9.
nec	—	—	*Naumann.* 1853. Atlas zu sein. Lehrb. der Geogn., t. 70, fig. 4.

P. testâ elongatâ, angustâ, turritâ, longitudinaliter nodo-costatâ, concentrice lineatâ: spirâ elevatâ, acuminatâ: anfractibus medio angulatis; marginibus posticis latis, declivis, vix cavatis, sub-lævibus, ad suturam incrassatis; ultimo anfractu brevi, antice coarctato; costis crassiusculis, brevibus; lineis concentricis filiformibus, sub-regularibus: aperturâ obovatâ, in canali brevi, mediocriter lato, leviter arcuato et retrorsum reflexo exeunti; sinu lato, profundo, subtrigono, mediâ in margine collocato.

Shell narrow, elongate, turreted, longitudinally ribbed, and spirally lined: the spire, which consists of nine volutions exclusive of the pullus, is pointed and much elevated, forming nearly two thirds of the entire shell. The whorls are sharply

angulated at the shoulders, to which the last but one of the concentric lines, more prominent than the others, gives the appearance of being carinated. By this keel-like line, the whorl is nearly equally divided; the anterior half, covered with the concentric lines, is flat-sided; the posterior half, forming the margin of the whorl, is very slightly channelled, almost straight, and smooth, except where it presents obscure curved lines, indicating the earlier outlines of the sinus, and is bordered round the suture by a single coarsish, thread-like, raised line. The posterior margins slope backwards, at an angle with the shoulders corresponding with that formed by the anterior portion of the whorl, giving a regular zig-zag outline to the spire. The ribs are moderately distant, not very broad, rounded, and short, barely extending to the middle of the whorls; the concentric lines are thread-like, rather thick, and separated by concave furrows as wide as the lines; excepting the one on the shoulders, they are nearly equal and regular. The aperture, which is of a widish-oval shape, terminates in front in a short, slightly oblique, and not very wide canal, the anterior extremity of which is a little bent backwards; the outer lip, as indicated by the lines of growth, is arched; and the sinus, which extends over the whole width of the margin, is deep and subtrigonal in shape.

The wide, straight margins, angular shoulders, and zig-zag outline of the whorls, which characterise this species, are not noticed in the description, nor represented in the figure given in the 'Mineral Conchology.' The present Pleurotoma, as described and figured in that work, would appear to resemble a well-known Miocene species (*Murex oblongus*, Brocchi, the *Pleurotoma dubia*, Jan.; *P. obeliscus*, Des Moul.; and *P. multinoda*, Grat.); and this, probably, has misled Bellardi and other continental authors into referring the Miocene shells to *P. brevirostrum*. In these shells, however, the posterior margins of the whorls are narrow and concave, the sides nearly parallel with the axis, the ribs long, extending to the front of the whorls, and the anterior canal is very short and wide. *P. brevirostrum*, in fact, more nearly resembles *P. Lamarcki*, Bell (*P. semistriata* of Partsch), a species described by Hörnes as occurring in the Tertiary Beds of Germany; and it agrees so closely with some Miocene shells, from the neighbourhood of Vienna, in the British Museum, that the latter cannot be regarded as specifically distinct. These shells have been, I think incorrectly, referred to *P. oblonga;* they are smaller and narrower than *P. Lamarcki*, and the margins of the whorls are not quite so concave, but they may be, probably, a variety of that species.

The shell on which the present species was founded, and for the use of which I am indebted to Mr. Sowerby, was presented to the late Mr. Sowerby by Lady Burgoyne, by whom it was stated to have been found at Muddiford; I do not know of any other specimen having hitherto been found, although the beds at Muddiford, Highcliff, and Barton have, probably, been explored more thoroughly than any other Eocene deposit in England. The shell in question does not present the aspect of

shells from that locality; and I am strongly inclined to think that by one of those accidents, which the greatest care will not always prevent, a shell from the Miocene beds of Germany or Italy has been mixed with Hampshire fossils, and that thus an erroneous locality has been given. The matrix, unfortunately, has been entirely removed, and this evidence is not available. Under these circumstances, I retain the species, for the present, as one of the English Eocene Pleurotomæ, but with much doubt.

Size.—Axis, $1\frac{1}{2}$ inch; diameter, 4-12ths of an inch.

Locality.—Muddiford?

No. 181. PLEUROTOMA NODULOSA. *Lamk.* Tab. XXIX, fig. 7, *a—c.*

PLEUROTOMA NODULOSA. *Lamk.* 1804. Ann. du Mus., vol. iii, p. 170, No. 18.
— — — 1822. Histoire Naturelle, &c., vol. vii, p. 101, No. 25.
— — *Desh.* 1824-37. Descr. des Coq. foss., &c., vol. ii, p. 466, t. 65, fig. 11—14.

P. testâ elongatâ, fusiformi, undique spiraliter lineatâ: spirâ elevatâ, acuminatâ: anfractibus ad humeros angulatis, nodulosis; lineis filiformibus, sub-regularibus; nodulis, obtusis, crassis, obliquis: ultimo anfractu per-brevi, postice concavo, antice depresso-convexo, repente coarctato, in canali brevi, latiusculo, obliquo, terminanti: aperturâ oblongo-ovali; labro tenue, aliforme; sinu latiusculo, paullo profundo, in margine collocato.

Shell elongated, fusiform, having the whole surface covered with concentric raised lines: spire pointed, produced, much exceeding the aperture in length; whorls angulated at the shoulders, where they present a series of blunt, thickish, rather oblong, tubercles, somewhat distant from each other, very slightly oblique, and becoming feeble and obscure on the last whorl; the posterior margins are a little concave. The last whorl is very short, flatly convex at the sides, contracted rather suddenly in front, and terminates in a short, and somewhat wide canal. The spiral lines are thickish, rounded, thread-like, equal, and nearly regular; the aperture is of an oblong-oval shape; the outer lip thin, wing-like, projecting at the middle, and smooth within; and the sinus, which is placed in the margin, is rather wide, not very deep, and triangular in form.

Lamarck describes the concentric lines which ornament the French shells as very thin; while in the English specimens the lineation is strong and coarse. This difference in the character of the sculpture on the Eocene shells of the two countries is not of unfrequent occurrence, and may be attributed to outward conditions only. The sinus in the outer lip is described by Deshayes as being "narrow and deep;" but in a series of specimens from Grignon, for which I am indebted to that gentleman, the sinus corresponds pretty closely with that found in the English specimens.

In all other respects the shells agree; and I do not feel any doubt, therefore, as to the accuracy of the identification.

With the Grignon specimens, I received some from Damery, in which the tubercles are thin and compressed, resembling small, oblique ribs; they form a variety, probably not known to Deshayes at the date of his work above cited, and therefore not noticed by him. Our English shells present the thick rounded tubercles characteristic of the type, and from which the specific name was taken.

Size.—My specimens have not attained the size of the French shells; of the largest the axis is 9-12ths of an inch nearly (18 millim.); the diameter 3·5-12ths of an inch nearly (7 millim.).

Localities.—Stubbington. *French:* Grignon, Parnes, Courtagnon, Damery (fide *Desh.*); Lattainville (fide *Graves*).

No. 182. Pleurotoma nodosaria. *F. E. Edwards.* Tab. XXIX, fig. 8 *a*, *b*.

P. testâ turritâ, tuberculo-costatâ, spiraliter lineatâ: spirâ acuminatâ, elevatâ: anfractibus convexis, ad humeros sub-angulatis; marginibus posticis depressis, vix canaliculatis, ad suturam lineâ elevatâ cinctis; ultimo anfractu brevi, antice valde coarctato, in canalem brevem producto; lineis spiralibus exilibus, proeminentibus, sub-distantibus: aperturâ ovata; labro parum arcuato; sinu lato, sub-semicirculari, anticâ in margine collocato.

Shell narrow, turreted, ribbed, concentrically lined: spire pointed, produced, much exceeding the last whorl in length: whorls convex on the sides, rather bluntly angulated at the shoulders, and crowned with a row of small, oval-shaped, vertical tubercles, impressed by the concentric lines; the posterior margins are depressed, very slightly furrowed, almost straight, and bordered round the suture by a single slender raised line; the spiral lines are slender, very prominent, and rather distant. The last whorl is short, and somewhat suddenly contracted towards the front, and terminates in a short, narrowish canal. The aperture is ovate; the outer lip slightly arched, and the sinus wide, nearly semicircular, and placed in the very front of the margin.

I possess but an imperfect specimen of this species, but the characters are so distinct that it appears worthy of being recorded.

Size.—Axis, 5-12ths of an inch; diameter 2-12ths of an inch.

Locality.—Southampton.

No. 183. Pleurotoma undata. *Lamk.* Tab. XXIX, fig. 11, *a*, *b*.

Pleurotoma undata. *Lamk.* 1804. Ann. du Mus., vol. iii, p. 169, No. 9.
— — *Lamk.* 1822. Hist. nat., &c., vol. vii, p. 99, No. 14.
— — *Desh.* 1824-37. Descr. des Coq. foss., &c., vol. ii, p. 456; t. 63, figs. 11—13; t. 64, figs. 21—23.

Nec Pleurotoma undata. *Bast.* 1825. Mém. Géol. sur les Env. de Bordeaux, p. 64, No. 7.
nec — — *V. Hauer.* 1837. Fossth. imtert. Becken v. Wien. Jahrb., p. 419, No. 98.
nec — — *Grat.* 1838. Cat. Zool., &c., du Bass de la Gironde, p. 46, No. 394.
nec — — *Grat.* 1840. Conchyl. foss., &c., du Bass. de l'Adour (Atlas Pleurot., t. 2, fig. 36).

P. testâ elongato-fusiformi, sub-turritâ, lineis spiralibus costulisque longitudinalibus ornatâ: spirâ acuminatâ: anfractibus convexiusculis, postice sub-canaliculatis; lineis concentricis crassiusculis, depressis, numerosis, undatis; costulis undatis, variis: aperturâ angusto-ovatâ, antice in canali brevi exeunti; labro tenuissimo, arcuato; sinu latiusculo, marginibus sub-parallelis, anticâ in margine collocato.

Shell oblong, fusiform, somewhat turreted, ornamented with spiral lines and longitudinal ribs; the spire pointed, produced, always exceeding the last whorl in length; whorls eight or nine (exclusive of a smooth, conical pullus of three volutions), convex, short, and bluntly angular on the shoulders. The posterior margins are slightly channelled; the sutural edges, in the young shells, are frequently bordered by a single row of small, roundish tubercles, which disappear on the fourth or fifth whorl, and the edges then become feebly and distantly crenulated, or they present three or four prominent, thread-like lines. The concentric lines are numerous, irregular, fine and thread-like over the margins, rather thick and depressed over the middle and front parts of the whorl, and slightly wavy on the last whorl; the longitudinal ribs are short, oblique, curved, and very variable in different specimens, both in size and number, sometimes being moderately large and distant, sometimes small and crowded. The aperture is of an oblong-oval form, and terminates in front in a short, somewhat narrow, and nearly straight canal; the outer lip is very thin, much arched, and expanded towards the middle; the sinus is moderately wide, deep, with nearly parallel margins, and placed in the very front of the margin, immediately behind the shoulder.

The transverse lineation in the English specimens is, as is not unfrequently the case, of a coarser character than that found in the French shells; and there is also a slight difference in the condition of the posterior margins. These variations, however, do not appear to be of sufficient importance to justify the separation of the English shells.

Size.—Axis, 1 inch and 2-12ths (30 millim.); diameter, nearly 5-12ths of an inch (10 millim.).

Localities.—Stubbington; *French:* Grignon, Parnes, Mouchy, Courtagnon (fide *Desh.*), Saint-Felix, Ully-Saint-Georges (fide *Graves*), la Vallée de l'Aisne (fide *Melleville*).

No. 184. Pleurotoma bracheia. *F. E. Edwards.* Tab. XXIX, figs. 9, *a*, *b*.

P. testâ parvâ, sub-fusiformi, turritâ, longitudinaliter costatâ, concentrice lineatâ: spirâ obtusiusculâ aperturam in longitudine paullo superanti: anfractibus planulatis, ad humeros angulatis, postice concavis, et unicâ serie nodulorum munitis; ultimo anfractu valde coarctato, in canalem breviusculum producto; costis numerosis, obliquis, angustis, fere ad basin tendentibus; lineis concentricis sub-distantibus, acutis, irregularibus: aperturâ angustâ, ovali; labro leviter arcuato, intûs prope sinum calloso; sinu lato, brevi, in margine collocato.

Shell small, fusiform, turreted, longitudinally ribbed, concentrically lined: the spire rather thick, and moderately elevated, being a little longer than the aperture: the whorls flat-sided, angulated at the shoulders; the posterior margins narrow, channelled, and furnished with a single row of largish round knobs, alternating with the ribs; the last whorl is much contracted in front, and ends in a wide, somewhat short, and oblique canal. The longitudinal ribs are moderately thick, rounded on the surface, separated by concave spaces as wide as the ribs, oblique, tapering towards the front, and extending to the anterior canal; the concentric lines are distant, prominent, and thread-like. The aperture is of a narrow, oval shape; the outer lip slightly arched, sharp on the edge, thickened within near the apex of the sinus, and presenting two transverse, oblong callosities, similar to those which characterise *P. callifera;* the sinus is shallow, rounded, and wide, extending over the whole of the posterior margin.

The only specimen I possess has probably not attained its full growth, but it presents an union of characters which distinguishes it from all its congeners. It is apparently very rare.

Size.— Axis, 3·5-12ths of an inch; diameter, 1·5-12ths of an inch.

Locality.—Barton.

No. 185. Pleurotoma sindonata. *F. E. Edwards.* Tab. XXIX, fig. 12, *a*, *b*.

P. testâ parvâ, gracili, fusiformi, undique spiraliter lineatâ, clathratâ: spirâ subconicâ, acuminatâ: anfractibus convexiusculis, ad humeros sub-carinatis, postice plicatis, marginatis; lineis spiralibus elevatis, filiformibus, irregularibus, suprâ margines fere obsoletis; lineâ unicâ humeros cingenti eminentiori, in juventâ denticulatâ: aperturâ ovali, antice in canali indistincto exeunti; labro leviter arcuato, ad marginem posticam late sinuato.

A small, slender, fusiform shell, spirally lined, and having an elevated, nearly conical and pointed spire, formed of six or seven volutions; the whorls very slightly convex and sharply keeled round the shoulders; the posterior margins wide, sloping gently

backwards, slightly channelled, a little thickened on the sutural edge, and bordered by a thickish raised line, the space between which and the shoulder is ornamented with a series of rather closely set, curved plications, formed by the successive margins of the sinus. The spiral lines are very faint, scarcely visible to the naked eye, over the margins of the whorls, but elevated, thread-like, and irregular over the middle and front parts, where they are strongly decussated by the lines of growth, which are prominent and regular; the surface of the whorls is finely cancellated by these decussating lines, suggesting the idea of the shell being covered with very fine linen; whence the name. The posterior line, girding the shoulders, is more elevated than the rest, giving the whorls the appearance of being sharply carinated; on the early whorls this posterior line is broken into oblong denticulations, which disappear as the shell approaches maturity. The aperture is of an oval form, and terminates in front in a short, wide canal; the outer lip is slightly arched, and presents a moderately deep sinus, extending across the margin, and somewhat triangular in form.

This very pretty shell appears to be quite distinct; it is rare.

Size.—Axis, 5-12ths of an inch nearly; diameter, not quite 2-12ths of an inch.

Locality.—Stubbington.

No. 186. PLEUROTOMA GRANULATA. *Lamk.* Tab. XXVIII, fig. 4, *a—c.*

PLEUROTOMA GRANULATA. *Lamk.* 1804. Ann. du Mus., vol. iii, p. 266, No. 21; vol. vii, t. 13, fig. 4, *a*, *b*.
— — *Lamk.* 1822. Hist. nat., &c., vol. vii, p. 101, No. 26.
— — *Desh.* 1824-37. Descr. des Coq. foss., &c., vol. ii, p. 476; t. 67, figs. 1—3.
Non PLEUROTOMA GRANULATUM. *Phil.* 1851. Tert. foss. Magdeb. (Palæontograph., vol. i, p. 67, No. 127; t. 9, fig. 13).

Var. FORMOSA (*Charlesw.*). *P. testâ elongato-fusiformi, sub-turritâ, longitudinaliter granulato-costellatâ, concentrice lineatâ: spirâ productâ, dimidium totius testæ in longitudine paullulo superanti: anfractibus convexiusculis, sub-angulatis, postice sub-canaliculatis, ad suturam granulatis; costellis numerosis, undosis, fere ad basin tendentibus; lineis concentricis crebris, duabus vel tribus lineis posticis proeminentioribus: aperturâ oblongo-ovali, in canali brevi, latiusculo exeunti; labro aliforme; sinu lato, sub-semicirculari, in margine collocato.*

Shell elongated, fusiform, ornamented with numerous longitudinal, narrow ribs, which are crossed by concentric, raised lines, and thickened into small, round knobs at the points of intersection, imparting a granulated character to the surface: the spire, formed of seven or eight volutions, is rather obtuse, and moderately elevated, somewhat

exceeding the aperture in length. The whorls are slightly convex; the posterior margins somewhat depressed and concave, giving a turriculate aspect to the spire; a single row of roundish or slightly oblique, oblong granulations runs round the sutural margin, the space between which and the shoulder is nearly equally divided by a raised line granulated by the prolongation of the costellæ over the margins; the costellæ, which are more or less curved in different individuals, extend a little beyond the middle of the whorls, and gradually attenuate as they recede from the shoulders; the concentric lines are prominent, numerous, and irregular; the two lines on the shoulder and on the margin being more elevated than the rest. The aperture is of an oblong, oval shape, and terminates in front in a short, moderately wide canal; the outer lip is thin, sharp on the edge, and wing-shaped; and the sinus, which is wide and nearly semicircular, occupies the whole breadth of the margin.

This Pleurotoma is one of the shells figured under the superintendence of Mr. Charlesworth, for the British Natural History Society, and the elegant ornamentation which characterises it, well merits the epithet selected for a specific name. The shell, however, in its general form and the character of the ornamentation, so closely resembles *P. granulata* (Lamk.), that it is difficult, if not impossible, satisfactorily to separate the two. It will be found, on comparison, that the English shell is broader, the spire not so pointed, and proportionately shorter, and the aperture, consequently, relatively longer than in the French shell. These distinctions may fairly be attributed to external conditions, and I therefore regard the English shell not as a separate species, but merely as a strongly marked local variety of *P. granulata*.

Size.—Axis, 5-12ths of an inch nearly (10 millim.); diameter, 2-12ths of an inch (4 millim.)

Localities.—Barton, Alum Bay (Stratum No. 29, Prestwich); Highcliff, where it occurs in such profusion that it may be regarded as one of the characteristic shells of that deposit; and Bracklesham Bay. *French:* Grignon, Parnes, Mouchy, Courtagnon (fide *Desh.*), Monneville, Varinfroy (fide *Graves*).

No. 187. Pleurotoma Headonensis. *F. E. Edwards.* Tab. XXVIII, fig. 17, *a—c.*

Pleurotoma Headonensis. (Edw. MSS.) *Morris.* 1856. Forbes's Tert. Fluv. Mar. Format. &c.; Mem. Geol. Surv., p. 155, t. 5, fig. 4.

P. testâ gracili, fusiformi, longitudinaliter semi-costellatâ, spiraliter sulcatâ: spirâ elevatâ, longitudine dimidium totius testæ paulo superanti: anfractibus convexiusculis, postice unico sulco profundo exaratis, ad suturam marginatis; costellis numerosis, per-brevibus, angustis, obliquis; sulcis spiralibus regularibus, sub-distantibus: aperturâ elongato-ovali, in canali latiusculo, brevi, excunti; labro leviter arcuato; sinu sub-triangulari, lato, minime profundo.

Shell slender, fusiform, longitudinally ribbed, and concentrically furrowed; spire pointed, elevated, forming rather more than half of the whole shell; whorls, six or seven, flatly convex; slightly thickened at the posterior edge, and bordered by a spiral, sharp, elevated, ridge-like line, which runs round the sutural margin, the space between which and the shoulder presents a deep, round furrow, obliquely plicated by the successive margins of the sinus. The longitudinal ribs are numerous, oblique, rounded, and very short, barely extending to the middle of the whorl, and frequently altogether lost on the last whorl; the spiral furrows are regular, moderately distant, and rather deep. The aperture is of a lengthened, ovate form, and terminates in front in a short, but distinct, and moderately wide, canal; the sinus is somewhat three-cornered in shape, wide, but not very deep, and placed in the margin.

Size.—Axis, 3-10ths of an inch; diameter, 1-8th of an inch.

Localities.—Headon Hill, Colwell Bay, Hordwell (Upper Marine formation), Lyndhurst; and Whitecliff Bay (fide *Forbes*).

No. 188. Pleurotoma vicina. *F. E. Edwards.* Tab. XXIX, fig. 10, *a*, *b*.

P. testâ parvâ, politâ, gracili, fusiformi, omnino concentrice crebri-sulcatâ: spirâ sub-conicâ: anfractibus planulato-convexis, in juventâ costellatis et sub-angulatis; marginibus posticis declivis, vix cavatis, plicatis, unicâ lineâ elevatâ prope suturam cinctis: aperturâ angustâ, ovali, antice in canali brevi, lato exeunti; labro acuto, arcuato; sinu lato, sub-trigono, anticâ in margine collocato.

Shell small, polished, slender, fusiform, ornamented with numerous, close-set, shallow furrows: the spire elevated, forming rather more than half of the shell; the whorls, six or seven, very slightly convex; the posterior margins, which slope gently backwards, are nearly straight, giving a sub-conical shape to the spire, and are girt round the suture by a single elevated, ridge-like line, in front of which appears a series of numerous curved plications formed by the successive margins of the sinus. The early whorls are obliquely ribbed and slightly angulated at the shoulders, but both these characters disappear as the shell approaches maturity. The aperture is of a narrow, oval shape, and terminates in front in a short, wide canal; the outer lip is sharp on the edge, arched, projecting most towards the anterior extremity; and the sinus, which is wide, moderately deep, and sub-trigonal in form, is placed in the very front of the margin.

This shell very closely resembles *P. Headonensis*, of which it may perhaps prove to be merely a variety. It is distinguished by the more slender form, the shorter spire, the more closely furrowed and less convex whorls, the absence of the costellæ,

except in the young state, and the nearly straight margins of the whorls instead of the deeply furrowed margins which characterise that species.

Size.—Axis, 4-12ths of an inch; diameter, 1-8th of an inch.

Locality.—Alum Bay (No. 29, Prestwich); rare.

No. 189. Pleurotoma turpis. *F. E. Edwards.* Tab. XXVIII, fig. 2, *a—c.*

P. testâ elongatâ, fusiformi, spiraliter sulcatâ, in juventâ costellatâ: spirâ productâ, bitrientes totius testæ in longitudine fere æquanti: anfractibus convexiusculis; ad humeros angulatis; postice declivis, late cavatis, ad suturam crenulatis; ultimo anfractu antice sensim attenuato, in canali perbrevi terminato; sulcis spiralibus crebris, undulatis, obscuris: aperturâ oblongo-ovali; labro arcuato, acuto; sinu sub-triangulari, lato, mediocriter profundo, in margine collocato.

Shell long, fusiform, spirally sulcated, and, in the young state, longitudinally ribbed; the spire much produced, forming nearly two third parts of the whole shell: whorls, seven or eight, slightly convex, angulated at the shoulders; the posterior margins slope gently backwards, are plicated round the sutural edge, and are deeply channeled, imparting somewhat of a turreted character to the spire; the body-whorl tapers towards the front with so gradual a contraction as to be almost conical. In the young shell the whorls present rather numerous, nearly straight ribs, which are lost about the fourth or fifth whorl. The spiral furrows are shallow, close-set, slightly undulating, obscure, and frequently decussated by the lines of growth. The aperture is a lengthened, ovate form, and terminates in front in a short, wide, indistinct canal; the outer lip is arched, thin, sharp-edged, and smooth within; and the sinus is three-cornered in shape, not very deep, and wide, extending across the whole width of the margin.

This Pleurotoma presents a general resemblance to *P. pyrgota;* the latter species, however, may be easily distinguished by the finely crenulated and more sharply angulated shoulders of the whorls and the prominent, ridge-like line which borders the suture.

Size.—Axis, rather more than 1 inch; diameter, 1-3d of an inch.

Localities.—Clarendon, Southampton.

No. 190. Pleurotoma subula. *F. E. Edwards.* Tab. XXIX, fig. 13, *a, b.*

P. testâ subulatâ, spiraliter obsolete lineatâ, fere lævi: spirâ elatâ, sub-conicâ: anfractibus antice planiusculis, postice cavatis, ad suturam sub-incrassatis, marginatis;

lineis spiralibus parum eminentibus, undulatis, supra margines posticas exilissimis, crebris, cæteris distantioribus: aperturâ oblongo-ovali (?), *in canali brevi exeunti; labro sub-recto; sinu lato, mediocriter profundo, sub-trigono, mediâ in margine collocato.*

Shell subulate, concentrically obscurely lined, almost smooth; spire nearly conical, elevated, equalling the aperture in length; whorls six (exclusive of a rather large, smooth pullus), depressedly convex, with gently sloping margins, widely channelled, slightly thickened round the suture, and girt by a narrow, raised band, rounded on the upper surface, and traversed by a single, faint, elevated line; the last whorl is much contracted in front, and terminates in a wide, short, but distinct, canal. The spiral lines are very faint, nearly obsolete, scarcely detracting from the otherwise smooth surface of the shell; over the margins they are close-set, but become more distant over the middle and front parts of the whorls. The aperture is concealed by the matrix, but, apparently, it is of a lengthened oval shape; the outer lip, as displayed by the lines of growth, is but slightly arched, nearly straight; and the sinus, which extends almost across the margin, is wide, moderately deep, and somewhat triangular in form.

The specimen figured is the only one I possess of this Pleurotoma; the nearly smooth surface, and tapering, conical spire, associated with the short, anterior canal and marginal sinus, distinguish it, however, from all its congeners.

Size.—Axis, 8-12ths of an inch nearly; diameter, not quite 3-12ths of an inch.

Locality.—Basingstoke.

No. 191. Pleurotoma lissa. *F. E. Edwards.* Tab. XXVIII, fig. 5, *a*, *b*.

P. testâ brevi, latâ, fusiformi, costellatâ, concentrice obsolete sulcatâ, politâ: spirâ sub-conicâ, dimidium totius testæ vix æquanti: anfractibus planulato-convexis, postice canaliculatis, lævibus, marginatis; ultimo anfractu antice coarctato, in canalem brevissimum producto; sulcis transversis rotundatis, distantibus, sulcis anterioribus perspicuis, cæteris obsoletis: aperturâ obovatâ; labro arcuato, acuto; sinu lato, fere semicirculari, in margine collocato.

Shell short, wide, fusiform, with a smooth, shining surface, longitudinally ribbed, concentrically furrowed; spire rather short, barely equalling the aperture in length; whorls, six exclusive of the pullus, flatly convex on the sides; the posterior margins smooth, deeply furrowed, and bordered round the sutural edge by a thick, raised band rounded on the upper surface; the last whorl is slightly contracted in the front, and produced into a short, very wide, canal; the longitudinal ribs are vertical, short, thick, rounded, smooth on the upper surface, and separated by spaces equalling the ribs in breadth; the ribs themselves are lost on the last whorl of the mature shell; the concentric furrows are rather wide; they are rounded and perspicuous over the canal

and front part of the whorl, but become obsolete over the middle and upper parts, so as not to detract from the otherwise smooth and shining surface. The aperture is of a narrowish, oval form; the outer lip arched, projecting slightly towards the front, thin, sharp-edged, and smooth within; and the sinus wide, nearly semicircular, and extending across the whole width of the margin.

The characters of this Pleurotoma are sufficiently well marked to merit distinction. Although presenting a close resemblance to *Pleurotoma tereticosta* in the general appearance, yet the smooth and shining surface of the shell, the more obtuse spire, the greater width of the whorls, the thicker and more distant ribs, the more conical form of the body-whorl, and the different condition of the sinus, separate the two species.

Size.—Axis, 5-12ths of an inch; diameter, 2-12ths of an inch.

Locality.—Potter's Bar.

No. 192. Pleurotoma Fisheri. *F. E. Edwards.* Tab. XXXI, fig. 14, *a*, *b*.

P. testâ elongatâ, turriculatâ, longitudinaliter costatâ, concentrice lineatâ: spirâ productâ, acuminatâ: anfractibus brevibus, convexis, ad humeros angulatis; marginibus posticis latis, depressis, paululo cavatis, ad suturam tuberculatis; cæterûm lævibus; ultimo anfractu sub-conico; costellis latiusculis, rotundatis; lineis concentricis antice distantibus; supra partes medianas anfractûum numerosioribus, irregularibus; supra margines posticas obsoletis: aperturâ ovali, in canali brevi, lato exeunti; sinu lato, sub-trigono, anticâ in margine collocato.

Shell long, narrow, turreted, longitudinally ribbed, and spirally lined; the spire pointed and much produced, forming nearly two thirds of the whole length of the shell. The whorls, seven or eight without the pullus, are short, angular at the shoulders, and nearly conical in front; the posterior margins wide, depressed, a little concave, and smooth, except on the sutural edge, where they present a single row of rather large and distant rhomboidal knobs, divided by a transverse furrow across the middle. The longitudinal ribs are short, broad, nearly vertical, rounded on the upper surface, and separated by concave spaces as wide as the ribs, which, in the last whorl, become reduced to oblong tubercles. The transverse lines are sharp and elevated, distant, and separated by smooth, flat spaces over the front of the whorls, but they become more numerous and irregular as they ascend the whorl from the middle towards the shoulder, and are altogether lost on the posterior margins. The mouth is of an oval form, and terminates in front in a wide and short, but distinct canal; the outer lip is thin, sharp-edged, and slightly arched, and the sinus, which is placed in front of the margin, is wide and somewhat triangular in shape.

This Pleurotoma approaches most nearly to *P. gomphoidea*, but the more turreted

spire, the short, nearly conical whorls, the broad, upright ribs, the distant, transverse lineation, and the short, anterior canal, render it easily distinguishable. I dedicate the species to the Rev. Osmond Fisher, the rector of Elmstead, near Colchester, a zealous and indefatigable fellow-labourer in this branch of Eocene Palæontology, to whose researches I am indebted for the discovery of the locality from which the species has been obtained.

Size.—Axis, not quite 5-12ths of an inch; diameter, 2-12ths of an inch nearly.

Locality.—Brook (New Forest).

No. 193. Pleurotoma Tallavignesii. *Rouault.* Tab. XXXIII, fig. 9, *a*, *b*.

Pleurotoma Tallavignesii. *Rouault*, 1848. Descr. des Foss. du Terr. Eocéne des Env. de Pau; (Mém. Soc. Géol. de France, vol. iii, 2d ser., p. 482, t. 16, figs. 18, 19.)

P. testâ elongato-fusiformi, turritâ, transversim irregulariter lineatâ, longitudinaliter costellatâ: anfractibus convexiusculis, angulatis; postice concavis, ad suturam marginatis; costellis numerosis, angustis, obliquis, bifurcatis; aperturâ elongato-angustâ, in canalem rectum longiusculum productâ; labro arcuato; sinu lato, sub-trigono, in margine collocato.

Shell elongated, fusiform, turreted, longitudinally ribbed, and concentrically lined; the spire moderately elevated, not equalling the last whorl in length: the whorls rather deep and slightly convex, almost flat-sided, and sharply angulated at the shoulders; the posterior margins wide, slanting, concave, and thickened along the sutural edge, where they present either three or four prominent, raised lines, or a narrow, ribbon-like band, sometimes bisected by a concentric furrow: the whole surface between the suture and the shoulders is ornamented by a series of curved plications, caused by the successive edges of the advancing sinus. The longitudinal ribs are numerous, narrow, oblique, much curved, and short, not extending beyond the middle of the whorls; they are not very prominent, and most frequently bifurcate shortly after their origin on the shoulders; the last whorl is much produced in front, where it forms a longish and moderately wide canal. The aperture is of a lengthened oval form; the outer lip is much arched, and presents in the posterior margin a widely sub-trigonal sinus.

The present species affords another instance of the identity of forms hitherto found only in the Lower Eocene deposits in England with forms characteristic of the Nummulitic Beds of France; but the English specimens agree so well with the figures and description given by Rouault, and more especially with his *Var. a*, that the identity can scarcely be questioned.

I have already pointed out the differences between the present species and *P. pyrgota*, the only English Pleurotoma which resembles it.

Size.—If the shell were perfect the axis would be about 1 inch and 4-12ths (34 millim.); diameter, 5-12ths of an inch (11 millim. nearly).

Localities.—Southend, Nuneham. *French:* Bos d'Arros (fide *Rouault.*

Additional Species.—Subdivision a. Canal elongated.*

No. 194. Pleurotoma Lehonii. *Rouault.* Tab. XXXI, fig. 13, *a*, *b*.

Pleurotoma Lehonii. *Rouault.* 1848. Foss. du Terr. Eocène des Env. de Pau; (Mém. Soc. Géol. de France, vol. iii, 2d ser., p. 485, t. 16, fig. 26.)

P. testâ elongato-fusiformi, transversim lineatâ, longitudinaliter costellatâ: anfractibus convexiusculis; marginibus posticis declivis, ad suturam leviter crenulatis; ultimo anfractu spiram in longitudine superanti; costellis obliquis, angustis; lineis transversis tenuibus, crebris, sub-regularibus: aperturâ ovato-angustâ, in canalem longum, angustum, sub-rectum, productâ; sinu lato, sub-trigono, in margine collocato.

Shell long, narrow, fusiform, longitudinally ribbed, and ornamented with concentric, raised lines; the spire is moderately produced, not equalling the last whorl in length. The whorls are slightly convex, with rather wide, slanting margins, slightly thickened, and very finely crenulated by the lines of growth along the sutural edge. The longitudinal ribs are rather prominent, narrow, not very distant, oblique, and curved, corresponding with the lines of growth, short in front, barely passing beyond the middle of the whorls, but reaching backwards to the very suture; the concentric lines extend over the ribs, and are fine, close-set, regular, and nearly equal. The aperture is of a narrow, ovate form, and terminates in front in a long, narrow, and nearly straight canal; the sinus is wide, sub-trigonal, and placed in the margin.

The English shells agree so well with the description and figures given by Rouault, that there does not appear to be any reasonable doubt of their identity with the species described by that author.

Size.—Axis, 7-12ths of an inch, nearly (14 millim.); diameter, 2-12ths of an inch (4·5 millim.)

Localities.—Highgate Archway. *French:* Bos d'Arros (fide *Rouault*).

No. 195. Pleurotoma macrura. *F. E. Edwards.* Tab. XXXIII, fig. 8.

P. testâ elongato-fusiformi, sub-turritâ, longitudinaliter costellatâ, omnino concentrice lineatâ: spirâ breviusculâ, in longitudine trientem totius testæ vix superanti: anfractibus

* The following three species, Nos. 194, 195, and 196, have been obtained since the publication of the first subdivision of the section distinguished by the sinus being placed in the margin; they are now added in order that the present monograph may contain descriptions of all the known English Pleurotomæ.

convexiusculis, postice concavis, oblique plicatis; ultimo anfractu antice in canalem rectum, prælongum producto; costellis numerosis, rotundatis, brevibus; lineis transversis confertis, supra partes anticas et medianas anfractûum inæqualibus, supra margines posticas tenuibus, regularibus: aperturâ obovatâ: labro leviter arcuato in margine late sinuato.

Shell long, fusiform, somewhat turreted, ribbed, and ornamented with concentric, raised lines, which cover the whole surface. The spire is pointed and short, scarcely exceeding one third of the whole length of the shell. The whorls are slightly convex, and bear on the shoulders a single row of rather closely set, short, oblique ribs, rounded on the upper surface, and separated by concave spaces as wide as the ribs; the posterior margins are broadly furrowed, and present a series of fine, curved plications, caused by the successive margins of the sinus; the last whorl is much contracted in front, and produced into a very long, straight canal. The transverse lines over the front and middle parts of the whorls are close-set, prominent, unequal, thickish, thread-like lines alternating with slender ones; over the posterior margins the concentric lines are very fine, numerous, equal, and granulated by the marginal plications. The aperture is of an oblong-oval form; the outer lip but slightly arched; and the sinus, which is placed towards the front of the margin, is wide, sub-trigonal, and not very deep.

This species appears to be very rare; and although my specimens are rather crushed, the long, narrow beak is too remarkable to be passed without notice.

Size.—Axis, 1 inch and 1-12th nearly; diameter, 4-12ths of an inch.

Locality.—Finchley.

No. 196. Pleurotoma cochlis. *F. E. Edwards.* Tab. XXXIII, fig. 6.

P. testâ elongato-fusiformi, turritâ: spirâ acuminatâ: anfractibus convexis, brevibus, ad humeros obtuse angulatis; postice late excavatis, marginatis, transversim subtilissime lineatis, cæterûm lævibus; ultimo anfractu repente coarctato, in canalem longum producto: aperturâ obovatâ; labro alæformi; sinu profundo, sub-trigono, mediâ in margine collocato.

A long, fusiform, turreted shell, with a much-produced, pointed spire, formed of nine or ten whorls: the whorls are convex, and obtusely angulated at the shoulders; the posterior margins remarkably wide, depressed, broadly furrowed, and ornamented with numerous, close-set, very fine, concentric, raised lines, nearly regular and equal, except those near the sutural edge, where five or six concentric lines, thicker and more prominent than the others, form a border round the suture; the middle and front parts of the whorls are smooth; the last whorl much contracted and produced in front into a long, straight canal. The aperture is of an oblong-oval form; the outer lip wing-shaped, projecting towards the front; and the sinus, which is placed in the middle of the margin, is deep and triangular.

This Pleurotoma, which is remarkable for the smooth surface and the short, cup-like form of the whorls, appears to be quite distinct; it presents a close resemblance to *P. regularis* (Van Bened.); but it is narrower, with a more pointed spire; and the whorls are shorter, wider, and with more depressed margins.

Size.—The extremity of the anterior canal is broken off; the axis of the perfect shell would be nearly 3 inches and 1-4th; diameter, 9-12ths of an inch.

Locality.—Shinfield.

Section I (*Shells fusiform*) *continued.*

B.—*Sinus on the shoulder of the whorl.*

a. Canal elongated.

No. 197. Pleurotoma aspera. *F. E. Edwards.* Tab. XXIX, fig. 14, *a*, *b*.

P. testâ elongatâ, fusiformi, sub-turritâ, lineis elevatis longitudinalibus spiralibusque sese decussantibus undique asperatâ: spirâ elevatâ: anfractibus antice planulatis, ad humeros obtuse carinatis, postice cavatis, marginatis; ultimo anfractu in canalem longum contortum, recurvum, producto; cariná tæniolæformi, denticulatâ: lineis longitudinalibus acutis undatis; lineis spiralibus præ-eminentibus, denticulatis: aperturâ oblongo-ovatâ; labro leviter arcuato, acuto, intús plicato; sinu oblongo, profundo, ad humerum collocato.

Shell oblong, fusiform, with a turreted, pointed spire, rather elevated, nearly equalling the aperture in length; the whole surface ornamented with numerous sharp, undulating, longitudinal, raised lines, decussated by concentric, raised lines, more prominent than the longitudinal lines, and denticulated at the points of decussation, imparting a rough character to the shell. The whorls are flat-sided, girt round the shoulders by a narrow, slightly raised, ribbon-like band, which gives to them the appearance of being obtusely keeled; and the posterior margins are concave, slightly thickened at the edge, and bordered by a sharp, elevated line, which runs round the suture; the band on the shoulders presents a series of narrow, vertical tubercles, corresponding with the longitudinal lines. The aperture is of an oblong-ovate form, and terminates in front in a long, narrowish, slightly curved canal, bent backwards at the anterior extremity; the outer lip is a little arched, thin, and sharp on the edge, thickened and strongly plicated within; and the sinus, which is placed on the shoulder, is oblong and very deep, with nearly parallel margins.

Occasionally specimens occur in which the posterior margins of the whorls, between the sutural ridge and the shoulders, are smooth; others, in which the margins

are covered by numerous very fine, closely set lines, either perfectly simple or feebly decussated by the longitudinal lines; and again, others in which the longitudinal lines are almost obsolete.

Size.—Axis, 1 inch; diameter, 4-12ths of an inch.

Localities.—Barton, Highcliff.

No. 198. Pleurotoma conifera. *F. E. Edwards.* Tab. XXXI, fig. 3, *a*, *b*.

P. testâ angustâ, elongato-fusiformi, sub-turritâ, undique spiraliter lineatâ: spirâ elevatâ, acuminatâ: anfractibus ad humeros sub-angulatis, in juventâ tuberculatis, deinde angustâ tæniolâ cinctis; postice leviter cavatis, marginatis; antice planulatis, sub-conicis; ultimo anfractu in canalem latum, mediocriter longum, reflexum producto; lineis spiralibus elevatis, filiformibus, confertis, sæpe irregularibus: aperturâ sub-quadratâ; labro ad humerum sinuato; sinu latiusculo, profundo, sub-trigono; columellâ contortâ, antice cristatâ.

Shell narrow, elongated, fusiform, sub-turreted, and ornamented with concentric raised lines; the spire pointed, elevated, rather exceeding the aperture in length; the whorls, seven or eight, exclusive of a small, smooth, sharply conical pullus of three volutions, are slightly channelled along the posterior margins, bluntly angulated at the shoulders, flatly convex at the sides, and tapering gradually towards the base; in the young state they present at the angle a row of small, vertical tubercles, but this ornament is lost on the third or fourth whorl, and is thence replaced by a narrow, smooth, ribbon-like band; the posterior margins are thickened round the sutural edge, which is crenulated and bordered by two spiral lines more prominent than the other marginal lines. The last whorl is produced in front into a long, wide canal, curved by the columella, and having the anterior extremity slightly bent backwards; the flattened sides and tapering form of the whorls impart to the spire the appearance of a succession of inverted cones, gradually diminishing in size, each being half concealed by the succeeding one. The elevated spiral lines are numerous and thread-like; sometimes they are regular and equal in size, but more frequently a very fine line intervenes between two thicker lines; and they are generally roughened by the prominent lines of growth. The aperture is sub-quadrate; the outer lip but little arched, thin, sharp-edged, and smooth within; the sinus is placed on the shoulder and is deep, rather narrow, and triangular in form; the columella is slightly twisted, and at the anterior extremity presents a small crest caused by the reflexion of the canal.

The present species appears to be well-marked; I do not know of any other Pleurotoma resembling it in the peculiar form of the spire, or in the elegant concentric lineation which adorns it. It is rare.

Size.—Axis, 10-12ths of an inch; diameter, 3-12ths of an inch.

Localities.—Bracklesham Bay, Bramshaw.

No. 199. Pleurotoma Volgeri. *Phil.* Tab. XXX, fig. 13, *a*, *b*.

Pleurotoma Volgeri. *Phillipi.* 1846. (Tert. Foss. Magdeb.) Paleontogr., vol. i, p. 69; t. 10 *a*, fig. 2.
— — *Morris.* 1854. Cat. Brit. Foss., p. 271.

P. testâ gracili, fusiformi, turritâ, tuberculatâ: spirâ acuminatâ: anfractibus convexis, ad humeros carinam acutam, serie tuberculorum dentiformium instructam, gerentibus; marginibus posticis latis, concavis, lævissimis; ultimo anfractu pluribus lineis spiralibus filiformibus, irregularibus, cincto, antice repente coarctato, in canalem longum producto: aperturâ ovali; labro leviter arcuato; sinu latissimo, sub-profundo, triangulari, ad carinam collocato.

Shell slender, fusiform, turreted, tuberculated: spire pointed, elevated, nearly as long as the aperture: whorls, six or seven, exclusive of the pullus, convex, sharply carinated at the shoulders; keel prominent, armed with a single row of rather closely set, small, tooth-like tubercles; the posterior margins wide, concave, and very smooth; the last whorl, which is ornamented over the middle with several thread-like, moderately distant, and nearly equal, raised, concentric lines, is contracted suddenly towards the front, and produced into a long, straight, and rather wide canal. The aperture is oval, the outer lip slightly arched, and the sinus, which is placed on the keel, is very wide, moderately deep, and triangular in form.

In the English specimens, the spire is rather more slender than that of the specimen figured and described by Philippi, and the spiral lines on the last whorl are nearly equal; in all other respects the two shells agree perfectly.

Size.—Axis, 7-12ths of an inch nearly (14 millim.); diameter, rather more than 2-12ths of an inch (5 millim.)

Localities.—Potter's Bar, where this pretty species appears to be very rare. Philippi's specimen is from the neighbourhood of Magdeburg; but the precise locality is not known.

No. 200. Pleurotoma Waterkeynii. *Nyst.* Tab. XXX, fig. 8.

Pleurotoma striatula. *De Kon.* (non *Duj.*) 1837. Coq. foss. de Baesele, &c., p. 27, No. 28, t. i, fig. 6.
— Waterkeynii. *Nyst.* 1843. Bull. Soc. Géol. de France, vol. xiv, p. 454, No. 29.
— — *Nyst.* 1843. Coq., &c., foss. de Belgique, p. 518, t. 41, fig. 4.
— striatula. *Bronn.* 1848. Index Palæont., p. 1010.
— Waterkeynii. *D'Orb.* 1852. Prod. de Paléontol, 26e Étage, No. 195, k.

P. testâ elongatâ, sub-turritâ, undique concentrice lineatâ: spirâ elevatâ, acutâ:

anfractibus convexiusculis, in medio obtuse carinatis; postice sub-concavis; lineis concentricis exilissimis, confertis, regularibus, lineis incrementi perspicuis decussatis: aperturâ ovato-oblongâ, antice in canali longo exeunti; labro alæforme, ad carinam sinuato; sinu angusto, profundo, trigono.

Shell oblong, sub-turreted, having the whole surface ornamented with concentric raised lines; the whorls, seven or eight exclusive of the pullus, are slightly convex, and bear on the shoulders an elevated widish-keel, rounded on the upper surface; the posterior margins are wide and slightly concave; and the last whorl, which is rather suddenly contracted in front, terminates in a moderately long, rather wide, and nearly straight canal. The concentric lines are slender, resembling very fine threads; regular, closely set, and decussated by the prominent lines of growth over the middle and front parts of the whorls; they are more distant and cancellated by the successive reflected margins of the sinus over the posterior margins. The aperture is of an oblong-oval form; the outer lip much arched, nearly semicircular, but projecting a little towards the front, thin and sharp at the edge, and smooth within; the sinus is placed on the shoulder, and is rather narrow, deep, and somewhat triangular in shape.

The ornamentation of the English shells varies from that of the Belgian specimens; in the former, the concentric lines are remarkably slender, crowded over the middle and front parts of the whorls, and more distant on the margins; in the foreign shells, on the other hand, they are thick and strong, and are distant over the middle of the whorls and crowded over the margins. The lines of growth in the English shells appear to be more prominent than in the Belgian specimens, and the concentric lines are therefore strongly decussated in the former, while in the latter they are described by M. de Koninck as *sub-clathratis*. In our specimens also, the successive lips of the sinus are very prominent, and the concentric lines over the margins are strongly decussated. In determining the identity of this shell, the distance in time must be taken into consideration, the Belgian shells belonging to the newer Eocene, and the English to the older Eocene; and notwithstanding the differences indicated, I believe that both are correctly referable to the same species.

The specific name, *striatula*, imposed by M. de Koninck had been previously applied by Dujardin to a Miocene Pleurotoma from Mantelin, and the name *Waterkeynii* substituted for it by M. Nyst, must therefore be adopted.

M. de Koninck describes the species as very rare in Belgium; it appears to be equally so in England.

Size.—Axis, 11-12ths of an inch nearly (23 millim.); diameter, 4-12ths of an inch nearly (8 millim.)

Localities.—Potter's Bar. *Belgian:* Basele, Anvers (fide *De Kon.*), Kleyn-Spauwen (fide *Nyst*).

No. 201. Pleurotoma mixta. *F. E. Edwards.* Tab. XXX, fig. 5, *a*, *b*.

P. testâ elongato-fusiformi, turitâ, costellatâ, concentrice sulcatâ simul atque omnino exilissime lineatâ et cancellatâ: spirâ elevatâ, obtusâ: anfractibus depresso-convexis, obtuse angulatis, prioribus costatis, cæteris ad humeros fasciolâ spirali cinctis; postice concavis, ad suturam marginatis; ultimo anfractu coarctato, in canalem longum, obliquum, producto; sulcis concentricis latis, minime profundis; lineis concentricis elevatis, irregularibus, lineis incrementi fortiter decussatis: aperturâ oblongo-ovali; labro arcuato, subalæformi, ad humerum sinuato; sinu latiusculo, profundo, sub-trigono.

Shell lengthened, fusiform, turreted, ribbed, spirally furrowed, covered with fine, concentric, undulating, raised lines, and cancellated; the spire is rather thick and elevated, exceeding the aperture in length. The whorls are bluntly angulated at the shoulders, flatly convex at the sides, almost conical in front; the posterior margins concave, and slightly thickened and crenulated on the sutural edges, where they present two rather distant concentric lines, more elevated than the rest. The early whorls are obliquely costellated, but the costellæ become feeble and obscure on the penultimate whorl, and are altogether lost on the last whorl, their place being supplied by a smooth, narrow, ribbon-like band, which girds the whorls round the shoulders, and is defined by two prominent lines and traversed along the middle by a third. The last whorl contracts gradually towards the front, and terminates in a long, moderately wide, oblique canal, slightly bent backwards at the extremity. The concentric furrows are wide, rather shallow and rounded, and the concentric lines are numerous, irregular, thread-like, and strongly decussated by the very prominent lines of growth. The aperture is of a lengthened, oval shape; the outer lip much arched, wing-shaped, projecting towards the middle, and apparently smooth within; and the sinus, which is placed on the shoulder, is moderately wide, very deep, and nearly triangular in form.

In the shape of the whorls, this Pleurotoma somewhat resembles *P. conifera;* it is, however, a longer shell, and the mixed character of the ornamentation, different from that of any other English Pleurotoma, entitles it to specific distinction. It is apparently very rare.

Size.—Axis, 1 inch and a half; diameter, 5-12ths of an inch.

Locality.—Barton.

No. 202. Pleurotoma divisa. *F. E. Edwards.* Tab. XXXI, fig. 17, *a*, *b*.

P. testâ fusiformi, longitudinaliter costellatâ, spiraliter obscure lineatâ: spirâ obtusâ, conicâ: anfractibus convexis, postice sulco concentrico exilissime lineato exaratis; costellis crassis, rotundatis, obliquis, curvis, ad suturam tendentibus, sulco marginali divisis; lineis spiralibus confertis, obsoletis: aperturâ ovali, antice in canali longiusculo exeunti; labro valde arcuato, ad humerum sinuato; sinu lato, paulo profundo, sub-trigono.

A wide, fusiform shell, longitudinally ribbed and concentrically lined; the spire thick, conical, and elevated, forming nearly one half of the entire length of the shell; the whorls, seven or eight, exclusive of the pullus, convex; the posterior margins narrow, hollowed out by a moderately wide and shallow spiral furrow, the concentric lines over which are more prominent and distinct than those over the other parts of the whorl; the last whorl contracts somewhat suddenly towards the front and terminates in a widish, moderately straight canal. The ribs are numerous, thick, rounded on the upper surface, arched and long, stretching backwards to the sutural margin, and extending in front to the canal; immediately behind the shoulder they are crossed by the marginal furrow, by which they are divided in two, giving to the spire the appearance of being girt by a double row of tubercles. The spiral lines on the early whorls are sharp and distinct; but on the later whorls, except over the marginal furrow, they are so feeble and obscure as scarcely to interfere with the smoothness of the surface. The aperture is oval; the outer lip much and regularly arched; and the sinus, which is placed on the shoulder, wide, shallow, and triangular in form.

The present species appears to be perfectly distinct; it is very rare.

Size.—Axis, 10-12ths of an inch; diameter, 4-12ths of an inch.

Locality.—Bracklesham Bay.

No. 203. Pleurotoma Selysii. *De Koninck.* Tab. XXIX, fig. 17, *a*—*d*.

Pleurotoma Selysii. *De Kon.* 1837. Coq. foss. de Basele, &c., p. 25, t. 1, fig. 4.
— rostrata. — — Ibid., p. 24, No. 23 (non *Sol.*) (excl. syn.)
— acuminata. — — Ibid., p. 24, No. 24 (non *Sow.*)
— Selysii. *Nyst.* 1843. Coq. et Polyp. foss. de Belg., p. 515, t. 40, figs. 11 *a*, 11 *b*, and 12.
— — *Nyst.* 1843. Bull. Soc. Géol. de France, vol. xiv, p. 453.

P. testâ fusiformi, turritâ, undique concentrice lineatâ; spirâ acuminatâ: anfractibus convexiusculis, postice excavatis, crenulatis, ad humeros tuberculato-plicatis; ultimo anfractu in canalem longiusculum producto; lineis concentricis supra margines et humeros confertis, exilibus, regularibus; cæteris crassioribus, distantioribus, irregularibus; plicis flexuosis: aperturâ oblongo-ovali; sinu latissimo, triangulari, ad humerum collocato.

Shell fusiform, elongated, turreted, concentrically lined: the spire pointed, elevated; whorls, seven or eight, without the pullus, slightly convex; the posterior margins concave and plicated along the sutural edge, where they present two or three very fine, sharp, elevated lines; the shoulders obscurely angulated, and ornamented with a series of rather distant tubercles, which on the early whorls are elongated, straight, and vertical, but on the last whorl become pliciform and curved; the last whorl is much contracted in front and produced into a rather long and widish canal. The concentric lines over the posterior margins and shoulders are close-set, regular, slender, and not very prominent; over the middle and front parts of the whorls they become more elevated, thicker, and more distant, with very fine, thread-like lines occasionally intervening. The aperture is of a narrow, elongated, oval form; the outer lip slightly arched, simple and smooth within; and the sinus, placed on the shoulder, is very wide, moderately deep, and triangular.

A close comparison of the English shells with Belgian specimens has confirmed me in the conclusion at which Mr. Morris and myself had arrived when a series of the latter was first submitted to us by Sir Charles Lyell; the shells from the two localities agree so closely that I do not feel any doubt of their specific identity.

It is a rare shell in England, although apparently abundant in Belgium, and in case the position of the Limburg beds has been rightly determined, the occurrence of this species in England is attended with additional interest from its being another instance of the reappearance of shells of the London Clay period in the fauna of the Upper Eocene epoch under nearly analogous mineral conditions.

Size.—Axis, 1 inch and 7-12ths (40 millim.); diameter, 6-12ths of an inch (13 millim. nearly).

Localities.—Highgate; Hampstead Railway Tunnel; Finchley; Muswell Hill. *Belgian:* Basele, Boom, Anvers (fide *De Kon.*), Rupelmonde, Gremittingen (fide *Nyst.*)

No. 204. Pleurotoma Koninckii. *Nyst.* Tab. XXIX, fig. 15, *a*, *b*.

Pleurotoma lævigata. *De Kon.* (non *Sow.*) 1837. Coq. foss. de Basele, &c., p. 27, t. 1, fig. 5.
— Koninckii. *Nyst.* 1843. Bull. Soc. Géol. de Fr., vol. xiv, p. 454.
— — *Nyst.* 1843. Coq. foss., &c., de Belg., p. 517, t. 41, fig. 3.

P. testâ elongato-fusiformi, concentrice lineâta: spirâ elatâ, acuminatâ: anfráctibus convexis, ad humeros in juventâ arcuato-plicatis, deinde inermibus; ad suturam, lineato-marginatis; ultimo anfractu antice gradatim attenuato; lineis concentricis confertis, sub-regularibus: aperturâ oblongo-ovali; canali antico, longiusculo, angusto; labro leviter arcuato, ad humerum sinuato; sinu lato, mediocriter profundo, sub-trigono.

A long, fusiform shell, ornamented throughout with concentric, raised lines; the spire, formed of six or seven volutions without the pullus, is pointed and much

produced, equalling the aperture in length. The whorls are convex, and in the young state, the shoulders present a series of curved and rather oblique plications; but as the shell enlarges, these become gradually smaller and indistinct, and at length altogether disappear on the last two whorls. The posterior margins are bordered round the suture by a narrow, elevated band, formed of two fine, undulating, thread-like lines, feebly crenulated; the last whorl tapers gradually and symmetrically towards the front, and terminates in a moderately long and narrow canal; the concentric lines are very numerous, a little more crowded in the margins than over the rest of the whorls, where they are even and regular. The aperture is of a narrow, oval shape; the outer lip thin, and but slightly arched; and the sinus, which is on the shoulder, is wide, moderately deep, and triangular in form.

The present Pleurotoma agrees so closely with *P. Koninckii*, that the identification can scarcely be questioned.

Size.—Of the perfect shell, axis rather more than 1 inch and 2-12ths (30 millim. nearly); diameter, nearly 4·5-12ths of an inch (10 millim.)

Localities.—Highgate, Potter's Bar, Hampstead Tunnel. *Belgian:* Basele, Boom, and Lethen (fide *Nyst.*).

No. 205. PLEUROTOMA GENTILIS. *Sowerby.* Tab. XXX, fig. 1, *a—c.*

PLEUROTOMA GENTILIS. *Sow.* 1850. Dixon's Geol., &c., of Sussex, p. 183, t. 6, fig. 25.

P. testâ elongato-fusiformi, turritâ, acuminatâ, spiraliter lineatâ, longitudinaliter costatâ: anfractibus antice convexis, postice concavis, ad suturam marginatis; costis numerosis, brevibus, rotundatis; lineis spiralibus supra margines posticas fere obsoletis, cæteris elevatis, irregularibus: aperturâ late ovali, in canali longo, angusto, sub-recto exeunti; labro arcuato, acuto; sinu lato, sub-trigono, summum ad humerum collocato.

Var. VETUSTA; *testâ minori; marginibus posticis anfractûum plus cavatis; costis longitudinalibus crassioribus; lineis spiralibus exilioribus.*

Shell fusiform, elongated, longitudinally ribbed, and spirally lined: the spire, consisting of eight or nine whorls, is pointed and moderately produced, nearly equalling the aperture in length: the whorls are convex at the sides, deeply concave round the posterior margins, and somewhat thickened along the sutural edge; the last whorl is much contracted in front, and produced into a long, nearly straight, narrowish canal. The longitudinal ribs are numerous, rounded, and short, barely extending over the middle of the whorl; the concentric lines are nearly obsolete over the hollowed margins, but very prominent over the other parts of the whorls, where they are rather thick and irregular, the lines in front of the shoulder being thicker and more elevated than the rest. The aperture is widely oval; the outer lip much arched, sharp on the edge, smooth within; and the sinus, which is placed at the very top of

the shoulder, almost in the margin, is wide, moderately deep, and somewhat three-cornered in shape.

Specimens occur in the London Clay in which the shell is smaller, the posterior margins of the whorls more roundedly concave, the ribs thicker and less numerous, and the concentric lines much finer and more closely set. I have described these as at variety of *P. gentilis*, but they may possibly be regarded as a distinct species.

Size.—Axis, 1 inch and 3-12ths; diameter, 5-12ths of an inch.

Localities. — Bracklesham Bay, Bramshaw, for the typical form; Clarendon, Alum Bay (Stratum No. 4, Prestwich), for the variety.

No. 206. Pleurotoma comma. *Sow.* Tab. XXX, fig. 2.

Pleurotoma comma. *Sow.* 1816. Min. Con., vol. ii, p. 105, t. 146, fig. 5.
— — ? *Phil.* 1836. Enum. Moll. Sic., vol. i, p. 200, No. 8.
— — ? *Phil.* 1844. Faun. Moll. regn. utr. Sicil., p. 173, No. 11.

P. testâ elongato-fusiformi, turritâ, costellatâ, concentrice lineatâ: anfractibus convexiusculis, postice concavis, medio lævibus, et ibi costellas numerosas, curvas gerentibus: aperturâ ovatâ, in canalem longiusculum, sub-rectum, productâ; sinu ad humerum collocato (?).

Shell elongated, fusiform, turreted, ribbed, and concentrically lined; whorls but slightly convex; almost straight-sided, concave along the posterior margins, smooth in the middle, and bearing round the shoulders a row of close-set short ribs, swelled at the upper part, curved and pointed below, somewhat resembling a comma; from which circumstance the specific name was taken. The aperture is ovate, and terminates in front in a moderately long and slightly curved canal; sinus on the shoulder (?).

The specimen on which this species was founded formed part of a collection which belonged to the late Mr. Holloway, of Portsmouth, and was presented by him to the Portsmouth and Portsea Literary and Philosophical Society. I have myself carefully searched through the museum belonging to that institution, for the specimen, but without success; and as I do not know of any other specimen, the above description has been prepared and the figure taken, by the permission of Mr. Sowerby, from those contained in the 'Mineral Conchology.'

Philippi has referred some shells from the basaltic tufa of Militello, in Sicily, to *P. comma;* but in the uncertainty which attends the present species, from the imperfect figure given of it in the 'Mineral Conchology,' and the want of any existing specimen for comparison, the identification must be accepted with hesitation. De Koninck has also erroneously referred to it certain shells from Basele, which Nyst subsequently distinguished as *P. crenata;* and the species has been quoted, by both Nyst and Bellardi, but with doubt, as identical with Basterot's *P. denticula.* To this last-men-

tioned species *P. comma* certainly presents a general resemblance, but is separable from it by the short curved costellæ, which ornament the shoulders, instead of the quadrate tubercles which distinguish *P. denticula.* The English species most closely resembling *P. comma* is *P. obscurata*, a species which may be reasonably expected to occur in the nearly synchronous deposit at Stubbington, and in which the narrow, oblong, compressed tubercles approach very nearly in character to the short costellæ of *P. comma;* the principal distinction appears to be in the condition of the middle of the volutions, which in *P. obscurata* are transversely lined instead of being smooth as in *P. comma;* but, although this difference does not appear to be of much value, I have not ventured, in the absence of any specimen of *P. comma* for comparison, to regard the two species as identical.

Locality.—Stubbington.

No. 207. Pleurotoma Prestwichii. *F. E. Edwards.* Tab. XXX, fig. 3, *a—d.*

P. testâ elongatâ, sub-fusiformi, longitudinaliter costatâ; spiraliter lineatâ: spirâ elevatâ acuminatâ: anfractibus rotundato-convexis; costellis numerosis, curvis; lineis spiralibus confertis, irregularibus, supra partes medias anfractuum obsoletis; cæteris perspicuis: aperturâ oblongo-ovali; labro arcuato, acuto; sinu ad humerum collocato, lato, profundo, sub-trigono.

Var.: testâ anfractibus convexiusculis, ad humeros angulatis, antice sub-conicis.

Shell lengthened, fusiform, longitudinally ribbed, spirally lined: the spire pointed, elevated, rather exceeding the aperture in length: the whorls, eight or nine, roundedly convex, a little thickened round the suture, and very generally bordered by two or three raised lines; the last whorl is much contracted in front and produced into a long, open, narrow canal. The longitudinal ribs are numerous, varying in number in different specimens, rounded, curved, scarcely extending in front to the middle of the whorls, but continued backwards to the very suture; the concentric lines close set and irregular, almost obsolete over the middle of the whorls, but elsewhere prominent and well defined; for the most part they are thick and rounded, but frequently smaller thread-like lines intervene. The aperture is of an oblong-oval shape; the outer lip much arched, projecting at the middle, thin and sharp on the edge, smooth within; and the sinus, which is placed on the shoulder, very wide, rather deep, and triangular in form.

A variety occurs plentifully in which the whorls are less convex on the sides, giving a subconical character to the spire, and are bluntly angulated at the shoulder; and the front part of the last whorl is not so much contracted as in the type.

Size.—Axis, 1 inch and 4-12ths; diameter, rather more than 5-12ths of an inch.

Localities.—Clarendon, where both forms are abundant, and Alum Bay (Stratum No. 4, Prestwich).

No. 208. PLEUROTOMA SIMILLIMA. *F. E. Edwards.* Tab. XXX, fig. 4, *a—c.*

P. testâ elongato-fusiformi, sub-turritâ, costellatâ, omnino spiraliter lineatâ: spirâ elatâ, acuminatâ: anfractibus convexiusculis, ad humeros obtuse angulatis; postice concavis, marginatis; costellis numerosis, angustis, sub-rectis; lineis spiralibus confertis, filiformibus, irregularibus: aperturâ ovali, in canali longo exeunti; labro arcuato; sinu lato, mediocriter profundo, sub-trigono, ad humerum collocato.

Var. CRASSILINEA; *testâ anfractibus acute angulatis, tribus vel quatuor lineis supra medias partes cinctis.*

A long, narrow, fusiform shell, ribbed and covered with elevated spiral lines: spire sub-turreted, pointed, equalling the aperture in length; whorls, seven or eight exclusive of the pullus, slightly convex, bluntly angulated at the shoulders, hollowed round the posterior margins and thickened at the sutural edges, which are bordered by one or two prominent raised lines. The ribs are numerous, narrow, nearly straight, short, not extending beyond the middle of the whorls, and becoming obsolete on the last whorl of the mature shell; the spiral lines are closely set, fine, thread-like and regular over the margins and shoulders of the whorls, but over the middle these lines alternate with others still more slender. The aperture is oval and produced in front into a long, narrowish, and nearly straight canal; the outer lip is arched, and presents at the posterior part on the shoulder of the whorl, a very wide and moderately deep sinus, triangular in shape.

In the variety noticed, the whorls are more sharply angulated, and they present over the middle, three or four coarse, elevated lines, with an occasional intervening slender line; but in other respects the shells agree with the typical form.

In the general aspect the present species closely resembles *P. Prestwichii;* but it may be distinguished from it by the turreted spire, the depressed concave posterior margins and the less convex sides of the whorls, and especially by the character of the longitudinal ribs, which are more numerous, straighter, and narrower, and do not extend backwards beyond the shoulders; whereas the coarse, obliquely curved ribs in *P. Prestwichii* reach up to the very suture; and the transverse lineation is also of a finer character. From *P. Wetherellii*, to which it also approaches, the present species is separated by the more slender form, the more vertical ribs, and the narrower posterior margins of the whorls.

Size.—Axis, rather more than 1 inch; diameter, 4-12ths of an inch.

Localities.—Highgate, Potter's Bar, Hampstead, Muswell Hill, Southampton, Alum Bay (Stratum No. 4, Prestwich), and Clarendon, at which latter place it is common. The variety occurs at Highgate, Potter's Bar, and Southampton.

No. 209. Pleurotoma zeta. *F. E. Edwards.* Tab. XXXI, fig. 16.

P. testâ oblongo-fusiformi, sub-lævi: spirâ sub-conicâ: anfractibus convexiusculis; marginibus posticis angustis, concavis; ultimo anfractu antice repente coarctato, in canalem longum, angustum, producto, supra canalem obscure lineato: labro vix arcuato, fere recto; sinu lato, minime profundo, ad humerum collocato.

A nearly smooth, oblong-fusiform shell, with a somewhat conical spire; the whorls slightly convex, having narrow posterior margins, obscurely channelled, with a simple sutural edge; the last whorl much contracted in front, and terminating in a long, rather narrow canal, over which appear a number of close-set, irregular, and very obscure concentric raised lines; the outer lip is scarcely curved, nearly straight, projecting towards the front, and the sinus, which is placed on the shoulder, is wide and very shallow.

Although I possess but one specimen, and that imperfect, the smooth surface of the shell, and the narrow, nearly straight outer lip, are characters so uncommon among the fusiform Pleurotomæ, that the present species ought not to be passed without notice.

The outline of the outer lip, indented by the sinus, somewhat resembles the form of the Greek letter *zeta*, from which circumstance the specific name is taken.

Size.—Axis, estimated at 1 inch and 8-12ths; diameter, $\frac{1}{2}$ inch.

Locality.—Bracklesham Bay.

No. 210. Pleurotoma tæniolata. *F. E. Edwards.* Tab. XXX, fig. 13, *a—c.*

P. testâ angustâ, elongato-fusiformi, sub-turritâ, concentrice lineatâ: spirâ elatâ, acuminatâ: anfractibus depresso-convexis, ad humeros tæniolâ cinctis, in juventâ tuberculatis; marginibus posticis latis, concavis, obsolete regulariter sulcatis; ultimo anfractu in canalem longum prolongato; lineis concentricis supra medias partes anfractuum elevatis, sub-distantibus, supra canalem minoribus, crebrioribus, fere obsoletis: aperturâ oblongo-ovali; labro sub-aliforme, ad humerum profunde sinuato.

A long, narrow, fusiform, and somewhat turreted shell, spirally lined; the spire pointed and much produced, considerably exceeding the aperture in length; the whorls, seven or eight without the pullus, are flatly convex, separated by a deep and very perspicuous suture, and girt round the shoulders by a narrow, slightly elevated, ribbon-like band, giving to the shell an appearance of being obscurely keeled; in the young state the shoulders present a series of small, rather closely set, tooth-like tubercles, which are lost in the later whorls. The posterior margins are concave, and very wide, sometimes concealing the preceding whorl up to the shoulder; the

hollow space between the suture and the shoulder is traversed by several irregular, shallow, almost obsolete furrows. The body whorl is much contracted in front, whence it tapers gradually to the base, forming a long, wide, and nearly straight canal: four or five concentric lines cross the middle of the last whorl; these lines are rounded, rather distant, and separated by wide concave spaces; over the front of the whorl, and as they descend the canal, the concentric lines become gradually closer and less prominent, and at last are almost obsolete on the anterior extremity of the canal. The aperture is of an oblong-oval form; the outer lip arched, somewhat wing-shaped, projecting slightly towards the posterior extremity; and the sinus, which is placed on the shoulder, is rather wide, very deep, and triangular.

In the series forming part of Mr. Wetherell's collection, two or three specimens occur in which the line of the suture being less decurrent, the margins of the whorls extend quite up to the shoulders; the shell, consequently, is a little wider, and the spire not so much elevated; but this difference appears to be accidental and scarcely constitutes a variety.

Size.—Axis, 1 inch and 1-8th; diameter, not quite 4-12ths of an inch.

Localities.—Highgate Archway, Cuffell.

No. 211. Pleurotoma Wetherellii. *F. E. Edwards.* Tab. XXIX, fig. 16, *a—d.*

P. testâ elongato-fusiformi, costellatâ, undique spiraliter lineatâ: spirâ mediocriter elatâ, sub-conicâ: anfractibus sub-angulatis, suturâ perspicuâ separatis, antice convexiusculis; marginibus posticis latis, sub-rectis; costellis numerosis, curvis; lineis spiralibus medianis distantibus, crassis, præ-eminentibus; cæteris filiformibus, crebrioribus: aperturâ oblongo-ovali, in canali longo exeunti; labro arcuato; sinu lato, profundo, ad humerum collocato.

Shell elongated, fusiform, ribbed and concentrically lined; the spire moderately elevated, rather thick, and nearly conical: the whorls, seven or eight, bluntly angulated at the shoulders, and slightly convex in front; the posterior margins wide and nearly straight. The ribs vary much in size, being more or less lengthened in the direction of the axis in different individuals; the concentric lines over the middle of the whorls are more or less distant, thick, and very prominent; over the shoulders and posterior margins they are finer, thread-like, more closely set, and irregular. The aperture is oblong-oval in shape, and terminates in front in a long, wide, and slightly oblique canal; the outer lip is much arched, thin and sharp on the edge, and smooth within; and the sinus is moderately wide, deep, sub-trigonal, and placed on the shoulder.

A variety occurs in which the posterior margins of the whorls are narrower, and the sutural edges slightly thickened.

The present species is found plentifully at Highgate, and I have dedicated it to my friend Mr. Wetherell, so long and so well known for his zealous labours in the London Clay, and his unrivalled collection of fossils from Highgate and the neighbourhood.

Size.—Axis, 1 inch and 7-12ths; diameter, 6-12ths of an inch nearly.

Localities.—Highgate, Holloway.

No. 212. Pleurotoma fasciolata. *F. E. Edwards.* Tab. XXX, fig. 12, *a*, *b*.

P. testâ elongatâ, fusiformi, sub-turritâ, omnino spiraliter fasciolatâ: spirâ elevatâ, in longitudine bi-trientes totius testæ superanti: anfractibus planulato-convexis, suturâ perspicuâ divisis, ad humeros obtuse carinatis; marginibus posticis latissimis, sub-rectis, contra spiram expressis: fasciolis spiralibus confertis, crassis, rotundatis, sub-regularibus, lineis incrementi fortiter asperatis: aperturâ ovato-oblongâ, antice in canali longiusculo, patulo, exeunti; labro aliforme, acuto; sinu profundo, latiusculo, ad humerum collocato.

Shell elongated, fusiform, sub-turreted, having the whole surface covered with narrow spiral bands; spire pointed, produced, fully equalling three fifths of the shell in length; whorls, seven or eight exclusive of the pullus, flatly convex on the sides, separated by a deep, perspicuous suture, and bearing on the shoulders a wide, slightly prominent keel, rounded on the upper surface, from which the spire derives its turreted appearance; the posterior margins are very wide, nearly straight, and extend up the spire almost to the keel on the preceding whorl; the spiral bands are numerous, thick, rounded on the upper surface, nearly regular, and much roughened, almost cancellated, by the coarse, prominent lines of growth. The aperture is of an oblong-oval form, and terminates in front in a wide, moderately long canal; the outer lip is much arched, and presents at the shoulder a deep and rather wide sinus.

Size.—Axis, 1 inch and 9-12ths; diameter, 7-12ths of an inch nearly

Localities.—Highgate, Railway Tunnel, Kilburn.

No. 213. Pleurotoma denticula. *Basterot.* Tab. XXX, fig. 7, *a*—*h*.

Pleurotoma denticula. *Bast.* 1825. Descr. Géol. du Bass. tert. Sud-ouest de la France, p. 63, t. 3, fig. 12.
— — *Defr.* 1826. Dict. des Sciences nat., vol. xli, p. 396.
— — *Grat.* 1832. Tab. des Coq. foss., &c., de Dax, p. 320, No. 318.
— — *Grat.* 1838. Catal. zool., &c., du Bass. de la Gironde, p. 46, No. 388.
— — *Desm.* 1842. Rev. de Pleurot., p. 47, No. 25.

PLEUROTOMA DENTICULA. *Nyst.* 1843. Descr. des Coq., &c., de la Belg., p. 526, t. 44, fig. 2.
— — *Bell.* 1845. Monogr. Pleurot. foss. Piem. (Mem. R. Accad. Sc. di Torino, 2d ser., vol. ix, p. 576, t. 3, fig. 7).
— — *Rouault.* 1848. Foss. du terr. Eocene des Env. de Pau (Mém. Soc. Géol. de France, 2d ser., vol. iii, p. 484, t. 16, fig. 22).
— SUBCARINATA? *Rouault.* 1848. Ibid., t. 16, fig. 23.
— PLEBEIA. *Sow.* 1850. Dixon's Geol., &c., of Sussex, p. 184, t. 6, fig. 23.
— — *Morris.* 1854. Catal. Brit. Foss., p. 270.
— — *Forbes.* 1856. Mem. Geol. Surv. (Tert. fluv.-mar. form., &c.), p. 154, t. 5, fig. 1, *a*, *b* (excl. var. *b*, fig. 2).

P. testâ fusiformi, turritâ, concentrice lineatâ: spirâ elatâ, acuminatâ: anfractibus ad humeros carinatis, tuberculatis; postice concavis, ad suturam lineâ elevatâ, acutâ, cinctis; ultimo anfractu brevi, in canalem longiusculum, sub-rectum producto; tuberculis transversim oblongis, medio sulcatis; lineis concentricis supra canalem et margines posticas anfractuum filiformibus, sub-æqualibus, supra medias partes elevatioribus, irregularibus: aperturâ obovatâ; labro arcuato, acuto, ad humerum sinuato; sinu profundo, sub-trigono.

Var. 1, LONGÆVA (fig. 7*d*); *testâ minori, angustiori: marginibus posticis anfractuum tuberculisque exilissime lineatis; tuberculis distantioribus, crassioribus.*

Var. 2, MACROBIA (fig. 7 *e*); *testâ breviori: ultimo anfractu tres vel quatuor lineas transversas eminentiores in medio gerenti.*

Var. 3, MUTICA; *testâ spirâ obtusiusculâ: lineis concentricis ad interstitia inter lineas majores et supra margines exilissimis, confertis, regularibus, æqualibus; tuberculis minoribus, ultimo anfractu sæpe obsoletis.*

Var. 4, GRACILENTA (fig. 7*f*); *testâ minori, graciliori: lineis concentricis elevatis, acutis, regularibus.*

Var. 5, CONULUS (fig. 7*g*); *testâ graciliori: spirâ elatiori, sub-conicâ: marginibus posticis anfractuum paullo declivis, vix cavatis; tuberculis minoribus, compressis, dentiformibus; lineis concentricis per lineas incrementi sub-decussatis, postice numerosioribus, regularibus, cæterum distantibus: canali antico breviori.*

Var. 6, ODONTELLA (fig. 7 *h*); *testâ minori, graciliori: lineis concentricis supra margines anfractuum exilissimis; tuberculis minimis, sub-dentiformibus.*

Shell fusiform, turreted, pointed, spirally lined, tuberculated: the spire, formed of eight or nine volutions, exclusive of a longitudinally ribbed conical pullus, is much produced, being nearly double the length of the aperture. The whorls are flatly convex at the sides, and rather broadly carinated at the shoulders, round which they present a series of transversely oblong tubercles, which are furrowed across the middle, and sometimes become obsolete on the last whorl; the posterior margins are narrow, concave, and bordered round the suture by a very prominent, sharp, ridge-like line; and one or two fine concentric lines traverse the hollow of the margins. The concentric lines over the anterior canal are rather close-set, thread-like, and nearly equal; over

the middle of the whorls they become more prominent, thicker, and irregular, very slender lines occasionally intervening between the larger ones: the last whorl is short, and terminates in front in a moderately long, narrow, and nearly straight canal. The aperture is obovate; the outer lip much arched, thin, sharp-edged, and most generally smooth and simple within, although in young specimens from Bramshaw the outer lip is occasionally plicated; the sinus, which is on the shoulder, is moderately wide, deep, and triangular in form.

The present species is widely spread, and in England ranges from the London Clay to the fluvio-marine deposits of Headon Hill; it is very variable, almost every locality presenting some modification of the dimensions or characteristic ornamentation of the shell. The typical forms described by Sowerby as *P. plebeia* are confined to the middle Eocene deposits; in the older deposits the species is represented by two varieties. In the first of these, var. *longæva*, from Highgate, the shell is narrower, and the posterior margins of the whorls, as well as the tubercles, are ornamented with very slender raised lines; this variety is narrower than the shells from the Bolderburg, referred by Nyst to Basterot's species, but it agrees with them in all other respects, particularly in the peculiar modification of the transverse lineation which characterises the latter shells. In the other variety, *macrobia*, from Clarendon, the spire is shorter, the posterior margins of the whorls are smooth, or they only present one or two feeble concentric lines, and the tubercles on the shoulders are more distant, larger, and coarser than in the typical form. In this modification the shells agree with those from Bos d'Arros, forming Rouault's var. D of *P. denticula;* and with it I should also have unhesitatingly associated the shells from the same locality constituting that author's species *P. subcarinata*, were it not for the different condition attributed to them of the embryonal whorls, of which the last two are described as being smooth instead of longitudinally ribbed. But for this distinction, the mature shells could not be satisfactorily separated from those forming the var. D of *P. denticula,* the slight differences which exist in the condition of the transverse lineation and of the tubercles not being, of themselves, of specific value. May not the smooth surface be due to disintegration, the outer layer of shelly matter in the pullus being, in general, more susceptible of decomposition than that in the mature shell? Recognising, however, the value of the character pointed out by Rouault, I have cited his species with doubt.

Among the forms found in the middle Eocene deposits at Bracklesham Bay, Brook, and Bramshaw, are those constituting the variety *gracilenta;* in these the shell is smaller and slenderer, the concentric lines are acute and nearly even, and the tubercles are neither so wide nor so prominent. This variety presents a close resemblance to some shells from Cuise-Lamotte (Sab. inf.), presented to me by M. Deshayes, and by him named *P. denticulata.*

In the upper Eocene deposits at Lyndhurst, Hordwell, Colwell Bay, and Headon

Hill, the species is represented by the variety *odontella;* in this the shell is more slender and shorter than in the typical form; the posterior margins are smooth or very feebly lined, and the tubercles are smaller and more pointed.

Besides these varieties, other forms occur which apparently are confined to the middle Eocene deposits. In the first of these, constituting the variety *mutica*, from Highcliff, the spire is obtuse, the concentric lines over the posterior margins and in the spaces between the prominent lines in front are crowded and so fine as to be barely visible to the naked eye; and the tubercles are very small, close-set, and frequently obsolete on the later whorls, which then present a simple, keel-like line on the shoulders.

In another variety, *conulus*, from Highcliff and Barton, the shell, as in the varieties *gracilenta* and *odontella*, is smaller and more slender than in the type; the spire is more produced, the margins of the whorls are nearly straight, imparting a conical character to the spire; the concentric lines over the margins are sharp, regular, and decussated by the prominent lines of growth, while those over the middle of the whorls are thin, elevated, distant, and simple; the tubercles are small and compressed, frequently assuming a tooth-like appearance; and the anterior canal is short and somewhat oblique. In all these varieties, however, the essential specific characters are preserved.

This species forms one of a group of Pleurotomæ which present a very striking similarity in their general aspect and ornamentation; they are all distinguished by the lengthened spire, the prominent transverse lineation, and the obtuse, tuberculated carina on the shoulders of the whorls, caused by the successive thickened extremities of the labial sinus. To this group belong *P.* (*Murex*) *monilis* (Brocchi) and *P. trifasciata* (Bellardi); species which appear to be separable from the present, not so much by differences in the transverse lineation or the condition of the carina, as by the greater width of the shells and the shorter and more cup-like form of the whorls. These peculiarities are particularly noticeable in the figure of *P. denticula*, as figured by Basterot. I have not been able to procure any well-authenticated Bordeaux specimens of Basterot's species; but the typical form of the shells described by Sowerby as *P. plebeia* so closely resembles not only specimens from Léognan, referred to *P. denticula*, with which I have compared them, but also those from Tortona and the environs of Turin referred to the latter species by Bellardi, while the varieties *longæva* and *macrobia* agree so well with the shells from the Bolderberg recorded by Nyst, and those from Pau described by Rouault, that in my opinion the English shells cannot be satisfactorily regarded as specifically distinct. The differences will be found to lie chiefly in the transverse lineation, the condition of the tubercles, or the internal plication of the outer lip. Now, the transverse lineation is a very variable character in the present species, frequently differing in specimens from the same locality; the

tubercles, as already observed, are due to the thickening of the extremity of the sinus, for the more easy protrusion of the excurrent siphon, and they may be reasonably presumed to be liable to variation; and, with regard to the plication of the outer lip, I have adverted to the occurrence of specimens from Bramshaw, in which that character is found. On these grounds I have considered that the shells described by Sowerby as *P. plebeia* ought to be referred to Basterot's *P. denticula*, although the figure given by Basterot is well calculated to lead to a different conclusion.

Size.—Axis, rather more than 1 inch (26 millim.); diameter, not quite 4-12ths of an inch (8 millim.)

Localities.—*London Clay:* Highgate, Potter's Bar, Southampton, Clarendon, Alum Bay (Stratum No. 4, Prestw.) *Middle Eocene:* Bracklesham Bay, Stubbington, Brooke, Bramshaw, Highcliff, Barton, Alum Bay (Stratum No. 29, Prestw.), Brockenhurst. *Upper Eocene:* Lyndhurst, Hordwell, Colwell Bay, Headon Hill, St. Helen's. *French:* Environs of Bordeaux, Dax, Touraine. *Italian:* Tortona, Environs of Turin. *Belgian:* The Bolderberg, near Hasselt.

No. 214. Pleurotoma crebrilinea. *F. E. Edwards.* Tab. XXX, figs. 8, *a*—*c*.

P. testâ elongato-fusiformi, turritâ, omnino transversim subtiliter lineatâ: spirâ obtusiusculâ, elevatâ: anfractibus depresso-convexis, ad humeros fasciolâ elevatâ ceu carinâ cinctis, postice concavis, marginatis; ultimo anfractu brevi, cyathiformi, antice valde coarctato: aperturâ ob-ovatâ, in canali longiusculo exeunti; labro leviter arcuato, ad humerum sub-triangulariter sinuato.

A long, fusiform, turreted shell, ornamented with numerous concentric, raised lines; the spire, formed of eight or nine volutions, is rather obtuse, and moderately elevated, forming half the length of the entire shell. The whorls are very slightly convex on the sides, deeply furrowed round the posterior margins, and angulated at the shoulders, round which they are girt by an elevated, ribbon-like band, forming an obtuse keel; the last whorl is short and much contracted in front, which imparts to it a cup-like form. The whole surface of the whorls is covered with numerous, very fine, close-set, raised lines; these lines, over the posterior margins of the keel, are equal and regular, but over the middle and front parts of the whorls they become unequal, other lines, slightly thicker and more prominent, occasionally intervening between the slender lines. The aperture is nearly oval in form, and terminates in front in a moderately long and nearly straight canal; the outer lip is but slightly arched and smooth within, and it presents at the shoulder a wide, three-cornered sinus.

I feel much hesitation in separating this Pleurotoma from *P. denticula*, of which it

may be regarded as a variety. The shell, however, is wider, the spire more obtuse, and the body-whorl shorter and more contracted in front; these differences, joined to the peculiar transverse lineation and the smooth, untuberculated keel, have induced me to regard the species as distinct.

Size.—Axis, 10-12ths of an inch; diameter, 4-12ths of an inch nearly.

Locality.—Stubbington.

No. 215. Pleurotoma callifera. *F. E. Edwards.* Tab. XXX, fig. 9, *a*, *b*; fig. 10, *a*, *b*; fig. 11, *a*, *b*.

P. testâ sub-turritâ, omnino concentrice lineatâ: spirâ obtusiusculâ: anfractibus depresso-convexis; ad humeros angulatis, fasciolâ tuberculatâ sulcoque spirali bipartitâ cinctis; marginibus posticis concavis, ad suturam lineâ elevatâ marginatis; lineis concentricis supra medias partes anfractuum et canalem distantibus, irregularibus, per-elevatis, denticulatis; supra humeros et margines posticas exilibus, confertis: aperturâ ovali, in canali breviusculo, obliquo exeunti; labro arcuato, ad humerum profunde sinuato, intûs callos duos oblongos, alterum verticalem, alterum transversum, gerente; sinu lato, triangulari.

Var. raphium (fig. 11, *a*, *b*); *testâ minori, angustiori; spirâ graciliori; lineis concentricis sub-distantibus, regularibus, simplicibus.*

Var. moniligera (fig. 10, *a*, *b*); *testâ spirâ elatiori: anfractibus postice granulato-marginatis; lineis transversis medianis distantioribus, præ-denticulatis.*

Shell elongated, turreted, ornamented with concentric, raised lines; the spire somewhat obtuse and elevated, exceeding the aperture in length; the whorls, seven or eight, flatly convex and angulated at the shoulders, round which runs a narrow, elevated band, traversed along the middle by a deep furrow, and presenting a series of close-set, regular, vertical tubercles, divided by the transverse furrow, and separated by concave spaces as wide as the tubercles; the posterior margins, which slope gently backwards, are concave and bordered round the suture by an elevated, sharp-edged, ridge-like line; the last whorl is much contracted towards the middle, and terminates in front in a rather short, moderately wide, oblique canal. The concentric lines are irregular, prominent, and evenly and rather strongly granulated; they are very fine and thread-like, close-set, regular, and simple, over the shoulders and posterior margins of the whorls; distant over the middle of the whorl, but more close over the canal. The aperture is ovate: and the outer lip, which is arched, thin, and sharp on the edge, presents within two oblong callosities; of these one is narrow, vertical, curved, and distant from the edge, and it extends from the sinus to the canal; the other is placed transversely, immediately over the posterior end of the vertical

callus, with the curved extremity of which it forms a wide, transverse groove, running into the sinus; the sinus is placed on the shoulder, and is wide, very deep, and triangular in form.

Specimens occur rather plentifully at Highcliff, constituting the variety *raphium*, in which the shell is smaller and narrower, the spire more slender and pointed, the margins of the whorls not so concave, and the concentric lines are moderately distant, even, regular, and smooth. Another variety, *moniligera*, is also found, but more rarely, in which the spire is longer, the elevated line bordering the posterior margins of the whorls is coarsely granulated, and the median transverse lines are more distant and more prominently denticulated.

In the general aspect of the shell and the character of the ornamentation, this Pleurotoma closely resembles the middle Eocene forms of *P. denticula;* but the callosities which present themselves on the inner surface of the outer lip indicate a peculiar modification of the excretory tube protruded through the sinus, which apparently entitles the present Pleurotoma to specific distinction.

Size.—Axis, 8-12ths of an inch; diameter, 3-12ths of an inch.

Localities.—Barton, Alum Bay (Stratum No. 29, Prestw.), Highcliff, where it is abundant, and Brook.

SECTION II. *Shells fusiform.*
B. *Sinus on the shoulder.* } continued.
b. Canal short or indistinct.

No. 216. PLEUROTOMA MONERMA. *F. E. Edwards.* Tab. XXXII, fig. 1, *a—c.*

P. testâ angustâ, elongatâ, turritâ, undique concentrice lineatâ: spirâ elevatâ, in longitudine bitrientes totius testæ fere equanti, acuminatâ: anfractibus convexiusculis, postice concavis, ad suturam bi-lineatis, ad humeros sub-angulatis, noduloso-plicatis; ultimo anfractu per-brevi, in canali lato, indistincto exeunti; plicis numerosis, verticalibus, arcuatis, utráque extremitate sub-nodulosis; lineis concentricis supra margines posticas et humeros anfractúum exilibus, confertis, equalibus, cæterum prominentibus, distantibus, irregularibus: aperturâ oblongo-ovali; labro arcuato, simplici; sinu lato, profundo, sub-trigono, ad humerum collocato.

Shell narrow, elongated, turreted, and ornamented with concentric, raised lines, which cover the whole surface; the spire, formed of seven or eight whorls, exclusive of a smooth, conical pullus of three volutions, is pointed and much produced, being nearly twice the length of the aperture. The whorls are slightly convex and obscurely angulated at the shoulders, where they present a series of regular, rather closely set, vertical plications, transversely furrowed along the middle, and swelled into small tubercles at

each extremity: these plications, which vary much in different individuals and frequently in the same specimen, become gradually less prominent as the shell approaches maturity, and are altogether lost on the last whorl. The posterior margins of the whorls are concave and bordered round the suture by two fine, thread-like, raised lines, frequently granulated by the lines of growth. The concentric lines over the posterior margins and shoulders of the whorls are very fine, closely set, equal, and but slightly raised; over the middle and front parts of the whorl they are distant, irregular, elevated, occasionally faintly granulated, and separated by broad, flat spaces, not infrequently traversed by single, very slender lines. The aperture is of an oblong-ovate form, and terminates in front in a wide, but short and indistinct, canal. The outer lip is much arched, rather wing-shaped, thin and sharp on the edge, and smooth and simple within; and the sinus, which is placed on the shoulder, is wide, very deep, somewhat triangular in form, with a broad extremity.

This Pleurotoma presents a remarkably close analogy with *P. uniserialis* (Desh.), to which species, in fact, it has generally been referred. It is, however, a wider and coarser shell, with a blunter spire, and the plications are more vertical, more irregular, and not so crescent-shaped as in the French shells; these variations, joined with the different condition of the sinus, which, in the French shell, is described as narrow, not deep, and with parallel margins, apparently justify a separation of the two shells.

Size.—Axis, one inch and 4-12ths; diameter, rather more than 5-12ths of an inch.

Localities.—Middle Eocene; Barton, Highcliff. *London Clay,* Clarendon.

No. 217. Pleurotoma varians. *F. E. Edwards.* Tab. XXXI, fig. 12, *a*, *b*.

P. testâ elongatâ, turritâ, omnino concentrice lineatâ: anfractibus sub-convexis; ad humeros obtuse angulatis, plicato-crenatis; antice repente coarctatis; marginibus posticis concavis, ad suturam marginatis; plicis angustis, cuneiformibus, obliquis; lineis concentricis posticis numerosis, equalibus; lineis medianis distantioribus, prominentioribus, granulatis: aperturâ ovali, in canali patulo, brevi, exeunti; labro leviter arcuato, acuto, intûs lævi; sinu ad humerum collocato sub-profundo, triangulari.

Shell elongated, turreted, concentrically lined; the spire, formed of six or seven volutions, is rather thick, pointed, almost mucronate, at the extremity, and much produced, equalling 3-5ths of the entire shell in length. The whorls are slightly convex, bluntly angulated at the shoulders, and ornamented with a single row of narrow, oblique, wedge-shaped crenulations, rather closely set in the early whorls, but becoming more distant on the penultimate and last whorls; the posterior margins are deeply furrowed and thickened round the suture, where they present a sharp, ridge-like line, frequently crenulated. The concentric lines over the posterior margins

and shoulders of the whorls are rather thick, equal, regular, and not very prominent; over the middle they are elevated, more distant, separated by concave spaces as wide as the lines themselves, and granulated; the last whorl is much contracted in front, and terminates in a wide and short, but distinct, canal. The aperture is widely ovate; the outer lip but slightly arched, thin, and sharp-edged, and smooth within; the sinus is moderately deep, rather wide and triangular in form, and placed on the shoulder.

The present Pleurotoma closely resembles *P. monerma*, but the plications on the shoulders of the whorls are very distinct in character, and the transverse lineation in this species is bolder, coarser, and more closely set; the aperture is more widely oval, and the sinus also is neither so deep nor so wide. These differences appear to be constant, for although possessing a good series of each species, I do not find specimens presenting intermediate characters, and in a comparison of the two series the eye at once recognises the distinctions.

Size.—Axis, 8-12ths of an inch; diameter, 3-12ths of an inch.

Locality.—Highcliff.

No. 218. Pleurotoma abnormis. *F. E. Edwards.* Tab. XXX, fig. 14, *a*, *b*.

P. testâ sub-turritâ, sub-conicâ, longitudinaliter costatâ, omnino concentrice sulcatâ: spirâ productâ, obtusiusculâ: anfractibus convexiusculis, postice canaliculatis, suturâ undulatâ, simplici divisis; ultimo anfractu in canali angusto, sub-obliquo terminato; costis sub-distantibus, longis, rotundatis, postice obliquis, ad humeros angulatis, antice curvis, attenuatis; sulcis numerosis, sub-æqualibus: aperturâ ob-ovatâ; labro leviter arcuato, acuto; sinu latissimo, minime profundo, triangulari, ad humerum collocato.

A turreted, nearly conical shell, longitudinally ribbed, and having the whole surface covered with concentric furrows: the spire rather obtuse and much produced, being nearly half as long again as the aperture. The whorls, eight or nine in number, are very slightly convex, channeled round the posterior margin, and separated by a simple suture, rendered undulating by the ribs of the preceding whorl. The ribs are rather numerous (twelve or thirteen), depressedly convex on the upper surface, long, extending from the suture to the canal, and separated by spaces equalling the ribs in width; on the margin the ribs are very oblique, but they are bent at a slightly obtuse angle when they reach the shoulder, whence they are prolonged, and become much attenuated towards the front of the shell, forming a gentle curve corresponding with the outline of the outer lip. The concentric furrows are numerous, regular, moderately deep, rather narrow, and separated by bands somewhat wider than the furrows, and rounded on the upper surface. The aperture is nearly oval, and terminates in front in a short, slightly oblique, and narrow canal; the outer lip is

slightly curved, projecting towards the front, thin, sharp-edged, and smooth within; the inner lip is very thin; the columella nearly straight and cylindrical; and the sinus, which is placed on the shoulder, is very wide, shallow, and triangular.

This singular species appears to be exceedingly rare; only four specimens are known to me, one of which (the figured specimen) is in my own collection, the other three form part of Mr. Wetherell's collection.

Size.—Axis, 1 inch and 3-12ths; diameter, 5-12ths of an inch.

Locality.—Finchley.

No. 219. PLEUROTOMA SCALARATA. *F. E. Edwards.* Tab. XXXI, fig. 6, *a*, *b*.

P. testâ elongato-fusiformi, turritâ, tuberculatâ, spiraliter lineatâ: spirâ acuminatâ, elevatâ: anfractibus angulatis, brevibus, convexiusculis; marginibus posticis angustis, depressis, ad suturam granulato-lineatis; ultimo anfractu repente coarctato, antice in canalem brevem, obliquum, producto; tuberculis numerosis, obliquis; lineis spiralibus confertis, filiformibus, irregularibus, sub-clathratis: aperturâ ovali; labro leviter arcuato, ad humerum sinuato; sinu latiusculo, sub-profundo, sub-trigono.

Shell elongate, fusiform, turreted, tuberculated, spirally lined; spire pointed, much produced, being more than half as long again as the aperture; whorls, eight or nine, exclusive of the pullus, angulated at the shoulders, and slightly convex in front; the posterior margins very narrow, depressed, furrowed, and bordered round the suture by a narrow band, traversed by one or two raised, spiral lines, which are occasionally broken into small, roundish, oblong tubercles; the last whorl is short, much contracted in front, and produced into a rather wide, short, but distinct, and oblique canal. The tubercles are numerous, oblong, narrow, slightly oblique, and a little compressed anteriorly. The spiral lines are crowded, thread-like, irregular, and unequal, slender lines frequently intervening between thicker lines; and they are roughened, almost decussated, by the conspicuous lines of growth. The aperture is oval, the outer lip very slightly arched, sharp-edged, and smooth and simple within; and the sinus, which is placed on the angle of the whorl, is moderately wide, not very deep, and somewhat triangular in form.

The coronated whorls, with their depressed, almost tabulated, margins, and the roughened lineation, give a marked character to this Pleurotoma, and will readily distinguish it from *P. obscurata.*

Size.—Axis, nearly 11-12ths of an inch; diameter, 3-12ths of an inch.

Localities.—Bramshaw, where it is not uncommon, Brooke, and Stubbington.

No. 220. Pleurotoma obscurata. *Sowerby.* Tab. XXXI, fig. 1, *a*, *b*.

Pleurotoma obscurata. *Sow.* 1850. Dixon's Geol., &c., of Sussex, p. 184, t. 7, fig. 19.
— — *Morris.* 1854. Cat. Brit. Foss., p. 270.

P. testâ angustâ, turritâ, omnino concentrice lineatâ, undulato-costatâ: spirâ elevatâ: anfractibus numerosis, convexiusculis; postice canaliculatis, ad suturam unicâ serie tuberculorum cinctis; antice coarctatis; lineis concentricis crebris, exilibus, regularibus; costis numerosis, brevibus, curvis, ad humeros præ-eminentibus: aperturâ ovali, in canali brevi, paullulo reflexo, exeunti; labro aliformi, ad humerum anguste et profunde sinuato; columellâ sub-rectâ.

A long, narrow, turreted shell, ornamented with numerous curved ribs, and having the whole surface covered with raised, spiral lines; the spire, which is formed of ten or eleven volutions, exclusive of the pullus, is much elevated, forming 3-5ths of the entire length of the shell; the whorls are flatly convex, and much contracted in front; and the posterior margins are slightly channeled, and thickened round the suture, where they present a single row of oblique, oblong tubercles. The ribs are numerous, short, and curved, following the outline of the outer lip; they are thick, rounded, and prominent on the shoulders, imparting somewhat of a turreted character to the spire, and they taper rapidly as they cross the middle of the whorls, where they are lost; the spiral, raised lines are thread-like, numerous, and irregular. The aperture is of a roundish-oval form, and terminates in front in a short, but distinct, rather wide, and nearly straight canal, having the anterior extremity slightly bent backwards; the outer lip is curved, wing-shaped, with the front part much projecting; the sinus, which is placed on the shoulder, is of a narrow, deep, oblong form; the columella nearly straight, and crested by the reflexure of the canal.

Size.—Axis, 1 inch and 3-12ths; diameter, rather more than 10-12ths of an inch.

Locality.—Bracklesham Bay.

No. 221. Pleurotoma lima. *F. E. Edwards.* Tab. XXXII, fig. 3, *a*—*c*.

P. testâ elongatâ, sub-turritâ, longitudinaliter curvo-plicatâ, concentrice scabro-lineatâ, tuberculato-carinatâ: spirâ elatâ, obtusâ: anfractibus planulatis, ad humeros angulatis; postice concavis, ad suturam granulatis; ultimo anfractu brevi, antice coarctato, in canali brevi obliquo, terminato; plicis longitudinalibus numerosis, acutis, ad basin tendentibus;

lineis concentricis medianis granulato-nodosis, irregularibus, alternatim filiformibus et tænioliformibus; aperturâ ob-ovali; labro aliformi; sinu angusto, profundo, marginibus sub-parallelis.

Shell elongated, slightly turreted, longitudinally plicated, concentrically lined; the spire obtuse, pointed at the extremity, and much produced, being half as long again as the aperture; the whorls, eight or nine, exclusive of a small, smooth pullus of two turns, are nearly straight-sided and angular on the shoulders, where they are girt by a narrow, slightly elevated band, which is furnished with a single row of small, close-set tubercles, in some few specimens rounded or oblong, but most generally narrow, curved, and pliciform; the posterior margins are narrow, concave, and bordered round the suture by a band, formed of two or three concentric lines more prominent than the rest, and presenting a series of small, oblong, or roundish tubercles; the last whorl is much contracted in front, where it forms a rather wide, short, but distinct, and oblique canal, notched at the extremity. The longitudinal plications are numerous, sharp, and curved, and they extend to the very base of the shell; the concentric lines over the shoulders and posterior margins are undulating, regular, even, rather thick, and separated by perspicuous furrows; over the middle and front parts of the whorls they are depressed, irregular, and unequal, narrow ribbon-like lines alternating with fine thread-like lines; at the points where they are intersected by the longitudinal plications, they rise into oblong tubercles, or become coarsely granulated, as the concentric line is more or less broad. The aperture is nearly oval; the outer lip wing-shaped, projecting most towards the posterior extremity, very thin and sharp on the edge, and smooth within; and the sinus, which is on the shoulder, is narrow and very deep, with nearly parallel margins.

The roughly granulated surface of this Pleurotoma has somewhat of the aspect of a coarse file, from which resemblance the specific name is taken. The species presents a very close analogy with the variety recorded by Deshayes of *P. bicatena* (Lamk.) In the French shells, however, the margins of the whorls are more depressed, and the spire, consequently, is slenderer, and tapers more regularly; the tubercles on the shoulders are longer, more prominent, and more distant, and the anterior canal is wider. In the shape and position of the sinus, as well as in the condition of the sutural tubercles and of the transverse sculpture, the shells agree, except that the decussation caused by the more prominent lines of growth have given to the English shells the scabrous aspect which characterises them. It may, perhaps, be considered as merely a strongly marked variety of Lamarck's species.

Size.—Axis, 10-12ths of an inch; diameter, 3-12ths of an inch.

Localities.—Barton, Alum Bay (Stratum, No. 29, Prestw.), and Highcliff, at all of which places it is somewhat rare.

No. 222. Pleurotoma reticulosa. *F. E. Edwards.* Tab. XXXII, fig. 4, *a*, *b*.

P. testâ elongato-fusiformi, undique concentrice lineatâ: spirâ acuminatâ: anfractibus convexis, ad humeros sub-angulatis et tæniolâ depressâ, obsolete curvo-plicatâ et sulco spirali angusto exaratâ, cinctis; postice concavis, ad suturam marginatis; ultimo anfractu in canalem latum brevem, antice reflexum, producto; lineis concentricis supra margines et humeros anfractuum confertis, tenuibus; cæterum fortibus, sub-distantibus, irregularibus; omnino lineis incrementi asperatis: aperturâ oblongo-ovali; labro arcuato, acuto, ad humerum sinuato; sinu latiusculo, profundo, sub-trigono.

Shell elongated, fusiform, having the whole surface covered with spiral, raised lines; spire pointed, produced, nearly equalling the aperture in length. The whorls, six or seven in number, are convex and bluntly angulated at the shoulders, which present a depressed, narrow, ribbon-like band, bearing a series of rather closely set, faint, crescent-shaped plications, formed by the successive rounded extremities of the sinus, and which are divided along the middle by a narrow but perspicuous furrow; the posterior margins are slightly concave, and bordered round the sutural edge by a coarse, elevated line; the last whorl is produced in front into a short, very wide, and slightly curved canal, the anterior extremity of which is bent a little backwards. The concentric lines are numerous and irregular, slender, and rather closely set over the margins and shoulders, but distant, thread-like, and much elevated over the middle and front parts of the whorls; and they are decussated by the perspicuous lines of growth, whence the surface has somewhat the appearance of being covered with fine network. The aperture is of a lengthened, oval form; the outer lip arched, thin, sharp at the edge, and smooth within; the sinus, which is placed at the shoulder, is rather wide, deep, and somewhat triangular in form, with a rounded extremity; and the columella is nearly straight, and presents a small crest in front.

In the general character of the ornamentation this Pleurotoma resembles *P. conifera;* but the lineation is of a rougher and more decided character; the shell itself is wider, the spire relatively shorter, the whorls more convex, the anterior canal shorter and wider, and the sinus not so deep nor so narrow. These differences strike the eye at once on comparing the two; and as the present shell occurs in a newer and distinct formation, I have retained it as a distinct species.

From *P. crenata* (Nyst), with which it also presents a close analogy, it is separable by the wider and more concave margins, and the crenulated and tuberculated shoulders of the whorls in that species.

Size.—Axis, 1 inch and 1-12th; diameter, 5-12ths of an inch.

Locality.—Barton, where it is rare.

No. 223. Pleurotoma rotella. *F. E. Edwards.* Tab. XXXI, fig. 4, *a*, *b*.

P. testâ turritâ, longitudinaliter arcuato-costellatâ, undique transversim sulcatâ: spirâ elatâ, acuminatâ: anfractibus sub rectis, ad humeros angulatis; postice concavis, granulato-marginatis; ultimo anfractu antice repente courctato, sub-angulato, in canalem brevem, latius-culum, emarginatum, producto; costellis distantibus, angustis, ad basin tendentibus, sæpe bifurcatis, postice sub-tuberculosis; sulcis transversis supra margines posticas et humeros confertis, angustis; cæterum latioribus, distantioribus: aperturâ obovatâ; labro arcuato; sinu lato, profundo, sub-semicirculari, ad humerum collocato.

A rather wide, turreted shell, longitudinally ribbed, and concentrically furrowed: the spire is pointed, much elevated, being nearly twice the length of the aperture, and formed of four or five volutions, exclusive of a smooth, lengthened, sub-cylindrical pullus. The whorls are nearly straight-sided, and angulated at the shoulders; the posterior margins narrow, concave, and slightly thickened round the suture, where they present a series of small, rounded, rather distant tubercles; the last whorl is suddenly contracted, so as to become obtusely angulated towards the front, and it terminates in a short, but distinct, and moderately wide canal, the anterior extremity of which is notched. The costellæ are rather distant, curved and narrow, and are swelled on the shoulders into small, oblong tubercles; thence they taper gradually, becoming sharp and elevated lines, not unfrequently furcated, towards the front, and they extend to the very base of the whorl; the concentric furrows are narrow, shallow, close-set, and regular over the posterior margins and shoulders, but are wider, deeper, and more distant over the middle and front of the whorls. The aperture is nearly oval; the outer lip thin, sharp-edged, and arched; and the sinus, which is on the shoulder, is wide, moderately deep, and rounded at the extremity.

This species presents some analogy with two Pleurotomæ from Cuise Lamotte, at present undescribed, but which have been named respectively *P. plicatella* and *P. normalis* by M. Deshayes, to whom I am indebted for specimens; in the first of these species, however, the shell is more slender, the spire more conical and pointed, the whorls more regularly convex, the posterior margins not so deeply channeled, the anterior canal longer, and the sinus wider and more trigonal; and in *P. normalis* the shell is wider, the spire more conical, the posterior margins of the whorls deeper and simple on the sutural edge, the costæ more distant and shorter, and the canal longer; the transverse ornamentation also consists of very slender, closely set, raised lines, and the sinus is placed in the margin.

Size.—Axis, 5-12ths of an inch; diameter, 2·5-12ths of an inch.

Localities.—Highcliff, where it is not uncommon, and Barton, where it appears to be very rare.

No. 224. Pleurotoma cedilla. *F. E. Edwards.* Tab. XXXI, fig. 5, *a*, *b*.

P. testâ turritâ, tuberculatâ, undique transversim lineatâ: anfractibus convexiusculis, ad humeros obscure angulatis, plicatis; postice concavis, tuberculato-marginatis; ultimo anfractu antice in canali lato, breviusculo, terminato; plicis numerosis, angustis, brevibus, arcuatis; lineis transversis regularibus; suprâ margines et humeros confertis, filiformibus, æqualibus; cæterum crassioribus, distantioribus: aperturâ oblongo-ovali; labro aliformi, ad humerum late breviterque sinuato.

Shell turreted, tuberculated, and concentrically lined; the spire pointed, moderately elevated, barely equalling the aperture in length; the whorls, six or seven, exclusive of a small, conical pullus of two volutions, slightly convex, obscurely angulated on the shoulders, and armed with a row of rather numerous, short, curved, pliciform tubercles; the posterior margins are slightly hollowed, and are thickened round the sutural edge, which is girt by a row of small, knob-like tubercles, not very distant from each other; the last whorl is much contracted in front, and produced into a rather wide and short but distinct, and oblique, canal, notched at the anterior extremity. The transverse lines over the shoulders and posterior margins of the whorls are slender, depressed, regular, equal, and close-set; those over the middle and front of the body whorl are coarser, and more distant, being separated by spaces as wide as themselves; they are somewhat undulating, and are roughened by the lines of growth. The aperture is of an oblong-oval form; the outer lip wing-shaped, projecting at the middle, thin, sharp-edged, and smooth within; and the sinus, which is wide, not very deep, and almost semicircular, is placed on the shoulder.

The present species is distinguished from *P. rotella* by the longer and more convex whorls, the short and curved folds on the shoulders, the wider and somewhat longer anterior canal, and the broader and shallower sinus. Like that species, it presents an analogy with *P. normalis* (Desh., *sp. ined.*), but the wider and straighter posterior margins, with their simple sutural edge, and the more sharply angulated shoulders of the whorls, the more slender and regular concentrical lineation, and the marginal position of the sinus of the latter shell, render the two species easily separable.

Size.—Axis, 6-12ths of an inch; diameter, rather less than 3-12ths of an inch.

Localities.—Barton and Alum Bay (Strat. No. 29, Prestw.), at both of which places it appears to be rare.

No. 225. Pleurotoma insignis. *F. E. Edwards.* Tab. XXXII, fig. 14, *a*, *b*.

P. testâ sub-turritâ, transversim denticulato-lineatâ: anfractibus depresso-convexiusculis, ad humeros angulatis, tuberculatis; marginibus posticis canaliculatis, ad suturam fasciolâ per-elevatâ, fastigii-formi, cinctis; ultimo anfractu, antice costellato, in canalem breviusculum producto; tuberculis numerosis, pliciformibus, obliquis; lineis concentricis supra margines posticas et humeros exilibus, regularibus; supra medium ultimi anfractûs distantibus, elevatis, scabratis: aperturâ ovali; labro arcuato, ad humerum sinuato; sinu lato, triangulari.

A somewhat broad, turreted shell, ornamented with concentric, raised lines; the spire, which consists of five or six volutions, is pointed and moderately elevated, forming about half the length of the whole shell. The whorls are angulated at the shoulders, and armed with a series of closely set, narrow, laterally compressed, oblique tubercles; the posterior margins are deeply channeled and are girt near the suture by a much-elevated, ridge-like band, which is granulated in the earlier whorls; the last whorl is depressedly convex on the sides, much contracted towards the front, and terminates in a narrow and rather short canal. The concentric lines over the posterior margins and immediately in front of the shoulder, are slender and rather closely set, distinct, and regular: on the middle of the last whorl appear four or five regular, concentric, raised lines; of these, the one nearest the shoulder is granulated and separated from that next in front by a very narrow, concave furrow; the raised line, second from the shoulder, is transversely denticulated, and in front of this appear two other almost equally prominent and moderately distant lines, which are also denticulated; the intermediate spaces are nearly flat, and are traversed along the middle by very fine and scarcely perceptible raised lines, also denticulated. Three or four much elevated sharp, or faintly granulated, concentric lines traverse the canal. The bases of the denticulations on the posterior median line, are prolonged into rather broad, flat, longitudinal ribs, which extend to the origin of the canal. The aperture is oval; the outer lip arched and indented at the shoulder by a very wide, moderately deep, sub-trigonal sinus.

This species presents some analogy with *P. denticula;* but the shell is broader, the spire shorter, the tubercles on the shoulder narrow and fold-like, the sinus much wider, and the sculpture different in character. It is apparently very rare.

Size.—Axis, rather more than 4-12ths of an inch; diameter, 2-12ths of an inch.

Locality.—Alum Bay (Strat. No. 4, Prestw.)

No. 226. Pleurotoma flexuosa. *Münster.* Tab. XXXII, fig. 8, *a—c.*

Pleurotoma flexuosa. *Munst.* 1835. Leonh. and Bronn, Jahrbuch, p. 449.
— — *Goldf.* 1826—1844. Petrefacta Germ., vol. iii, p. 21, t. 171, fig. 7.

P. testâ elongato-fusiformi, longitudinaliter flexuoso-plicatâ, spiraliter lineatâ: spirâ elatâ, sub-conicâ: anfractibus depresso-convexiusculis; postice ad suturam sulco angusto exaratis, lineato-marginatis, nonnunquam granulatis: aperturâ oblongo-ovali, antice in canalem breviusculum, ad basin emarginatum, productâ; labro leviter arcuato, ad humerum late sinuato; sinu mediocriter profundo, triangulari.

A long, narrow, fusiform shell, ornamented with numerous longitudinal plications and spiral raised lines; the spire is pointed and elevated, forming almost three fifths of the entire length. The whorls, seven without the pullus, are depressedly convex, nearly flat-sided, imparting a conical aspect to the spire; the posterior margins are rather deeply, but not widely, channeled, and are bordered round the suture by a sharp, prominent line, generally simple, but sometimes crenulated by the lines of growth; the last whorl is much contracted towards the front, and terminates in a wide and short, but distinct, canal, slightly notched at the extremity. The longitudinal plications are narrow and curved, and extend from the sutural border to the middle of the whorl; the spiral lines are numerous, slender, nearly equal, and rounded on the surface. The aperture is of an oblong-oval form, the outer lip very slightly arched, and the sinus, which is on the shoulder, is wide, not very deep, and triangular in shape.

The present species presents a close analogy with *P. Prestwichii*, but it is a narrower and slenderer shell, with a longer spire and less convex whorls, a straighter outer lip, and a shorter anterior canal. Our English specimens agree closely with a specimen of *P. flexuosa* from Hermsdorf, part of a series from the older Tertiaries of Germany, presented by Dr. Wedding to the British Museum.

Size.—Axis, 8-12ths of an inch; diameter, 3-12ths of an inch, nearly.

Localities.—Shenfield, Southampton, Clarendon, Highgate? Alum Bay (No. 4, Prestw.) *German:* Sternberg (fide Goldf.), Hermsdorf (fide Wedding).

No. 227. Pleurotoma pupoides. *F. E. Edwards.* Tab. XXXII, fig. 11, *a*, *b*.

P. testâ elongato-fusiformi, omnino concentrice sulcatâ: spirâ elatâ, conoideâ: anfractibus sub-convexis, inermibus, postice cavatis; ultimo anfractu ad humerum fasciolâ angustâ cincto, antice in canalem brevem obliquum prolongato; sulcis concentricis confertis, regu-

laribus, æqualibus: aperturâ oblongo-ovali; labro fere recto; sinu lato, mediocriter profundo, rotundato, ad humerum collocato.

Shell elongated, fusiform, concentrically furrowed; the spire nearly conical and moderately elevated, not quite equalling the aperture in length. The whorls, seven or eight without the pullus, are depressedly convex and are smooth and without ornament on the shoulders; the posterior margins, which slope very gently backwards, are traversed by a rather wide and deep concave furrow, and their sutural edge is simple; the last whorl is girt round the shoulder by a narrow, riband-like band, scarcely elevated above the surface; it is much contracted towards the front, and terminates in a wide and short, but distinct, canal, notched at the anterior extremity. The concentric furrows are numerous, not very deep, even, and regular, and are separated by ridges of equal width with themselves, and rather depressed on the upper surface. The aperture is of an oblong-oval shape; the outer lip is very little arched, nearly straight, and situated on the shoulder; and the sinus is wide, moderately deep, and rounded at the extremity.

This species is closely analogous with *P. flexuosa* (Münst.), of which, perhaps, it may be considered a variety; but the posterior margins are wider and more broadly furrowed, and the whorls do not present the curved costellæ, nor are they bordered round the suture by the sharp, elevated line, found in that species.

Size.—Axis, 9-12ths of an inch, nearly; diameter, not quite 3-12ths of an inch.

Localities.—Clarendon, Alum Bay (Stratum No. 4, Prestwich), and Potter's Bar.

No. 228. Pleurotoma variata. *F. E. Edwards.* Tab. XXXI, fig. 11.

P. testâ elongatâ, angustâ, sub-cylindricâ, sub-turritâ, longitudinaliter obsolete plicatâ, transversim irregulariter sulcatâ: spirâ elatâ, bi-trientes totius testæ fere æquanti: anfractibus convexiusculis; marginibus posticis paullulo cavatis, ad suturam granoso-lineatis; sulcis transversis supra margines posticas et humeros angustis, confertis; cæterum latioribus, distantioribus: aperturâ ob-ovali, in canali brevi, obliquo exeunte; labro valde arcuato; sinu lato, profundo, ad humerum collocato.

Shell long, narrow, somewhat turreted, and ornamented with obscure longitudinal plications, and irregular concentrical furrows: the spire is obtuse, sub-cylindrical, and much produced, being nearly double the length of the aperture. The whorls are depressedly convex; the posterior margins, which slope gently backwards, are very slightly furrowed, and are bordered round the suture by a single row of very small granulations. The transverse furrows over the posterior margins and shoulders of the whorls are narrow, shallow, and irregular, those near the suture being more closely set than the others; over the middle and front parts of the whorls the furrows are broader and

wider apart, being separated by spaces as wide as themselves; they are flattened on the upper surface and roughened by the lines of growth. The whorls present a series of faint, almost obsolete, longitudinal, curved plications, representing the successive edges of the outer lip, and which on the last whorl extend almost to the base. The aperture is nearly oval, and terminates in front in a wide, short, and oblique canal; the outer lip is much arched, thin, and sharp-edged; and the sinus, which is placed on the shoulder, is very wide, deep, and almost semicircular in shape.

Size.—Axis, nearly 6-12ths of an inch; diameter, not quite 2-12ths of an inch.

Locality.—Clarendon, where it apparently is very rare.

No. 229. Pleurotoma Woodii. *F. E. Edwards.* Tab. XXXII, fig. 10, *a*, *b*.

P. testâ turriculatâ, omnino concentrice lineatâ: spirâ elevatâ, acuminatâ: anfractibus planulatis, ad humeros obtuse angulatis, et cariná latissimâ, rotundatâ, in medio spiraliter sulcatâ, instructis; marginibus posticis angustissimis, depressis: lineis concentricis supra partes medias et anticas anfractúum sub-distantibus, latis, depressis; supra carinam et margines posticas fere obsoletis: aperturâ sub-quadratâ, in canali brevi exeunte: labro parum arcuato; sinu semicirculari, ad carinam collocato.

Shell turreted and spirally lined, with a pointed, elevated spire, rather longer than the aperture; whorls, eight, exclusive of the pullus, nearly straight at the sides, and obtusely angulated at the shoulders, where they present a very broad, prominent, rounded keel, traversed along the middle by a narrow and shallow furrow, representing the progress of the extremity of the sinus; the posterior margins are exceedingly narrow, depressed, and concave, and are simple on the sutural edge. The concentric lines over the middle and front parts of the whorls are rather numerous, regular, band-like, depressedly convex on the upper surface, and separated by deep concave furrows, equalling the bands in width; over the keel and posterior margins the concentric lines are nearly obsolete. On the early whorls the lines of growth are very perspicuous, resembling small, oblique costæ; these are lost on the last two whorls. The aperture, owing to the somewhat flat sides and the depressed posterior margin of the whorls, is subquadrate in form, and terminates in front in a short, moderately wide canal, rendered slightly oblique by the curve of the columella; the outer lip is very little arched, almost straight, and is smooth within; and the sinus, which is on the keel, is moderately wide and semicircular.

This well-marked Pleurotoma is extremely rare; I have dedicated it to Mr. Searles Wood, by whom it was discovered, and to whose liberality I am indebted for the specimen figured.

Size.—Axis, 5-12ths of an inch, nearly; diameter, 2-12ths of an inch.

Locality.—Headon Hill.

No. 230. Pleurotoma curta. *F. E. Edwards.* Tab. XXXI, fig. 2, *a*, *b*.

P. testâ parvâ, subfusiformi, turritâ, tuberculo-plicatâ, undique transversim sulcatâ: spirâ sub-conicâ, acuminatâ; anfractibus convexiusculis, ad humeros sub-angulatis, tuberculatis; postice concavis, granulato-marginatis; ultimo anfractu repentissime coarctato, in canalem brevem producto; tuberculis sub-distantibus, oblongis, bifurcis, plicas duas arcuatas formantibus; sulcis transversis confertis, supra canalem perspicuis, cæterum fere obsoletis: aperturâ obovali; labro leviter arcuato; sinu lato, brevi, sub-trigono, ad humerum collocato.

Shell small, rather fusiform, turreted, tuberculous, and concentrically furrowed: the spire, somewhat conical, pointed, and moderately elevated, being of equal length with the aperture. The whorls are very slightly convex, and bluntly angulated at the shoulders, where they are furnished with a row of short, vertical, oblong tubercles, which bifurcate in front, and are produced into two narrow, oblique, unequally arched, fold-like costellæ, which extend to the beginning of the canal; the posterior margins are rather deeply channeled and bordered round the suture by a single row of small, round granulations, corresponding with the tubercles on the shoulders; the last whorl is suddenly and much contracted towards the front, resembling that of *P. coarctata*; the transverse furrows are numerous, perspicuous over the canal, but elsewhere nearly obsolete. The aperture is rather widely oval; the outer lip moderately arched; and the sinus, which is placed on the shoulder, is wide, rather deep, and semi-elliptical in form.

I know only the figured specimen of this species, and this is probably an immature individual. It presents a close resemblance to *P. bracheia*, with which, without a careful examination, it may be easily confounded. On comparing the two shells, however, it will be seen that in the present species the spire is more regularly tapering, the posterior margins a little more depressed and more deeply channeled; the granulations round the suture smaller, and placed opposite to the tubercles on the shoulders, and the body whorl much more contracted. These differences, with the bifurcated tubercles, the different character of the transverse ornamentation, and especially the shape and position of the sinus, are sufficient to entitle the present shell to specific distinction.

Size.—7-24ths of an inch; diameter, 3-24ths of an inch.

Locality.—Alum Bay (Strat. No. 29, Prestw.)

No. 231. Pleurotoma puella. *F. E. Edwards.* Tab. XXXI, fig, 15, *a*, *b*.

P. testâ elongato-fusiformi, spiraliter granoso-lineatâ: spirâ elevatâ, obtusiusculâ, sub-conicâ; anfractibus convexiusculis, ad humeros unicâ serie tuberculorum brevium ornatis;

postice sulco spirali, exilissime lineato, exaratis; ad suturam duplici lineâ elevatâ undulatâ marginatis; ultimo anfractu in canali brevi, latiusculo, recurvo, desinente: lineis spiralibus alternatim crassis et tenuissimis; lineis crassis per-elevatis et per lineis incrementi granulatis: aperturâ ovali; labro leviter arcuato; sinu lato, mediocriter profundo, subtrigono, ad humerum collocato; columellâ arcuatâ, cristatâ.

Shell elongate, fusiform, and ornamented with concentric, granulated, raised lines; spire thick, nearly conical, and much produced, fully equalling three fifths of the entire shell in length. The whorls, eight exclusive of the pullus, are slightly convex, and girt round the shoulders by a single row of small, oblong, curved, comma-like tubercles; the posterior margins are nearly straight, and furrowed by a broad, deep sulcus, which is traversed by a few concentric lines, so faint as scarcely to detract from the smoothness of the surface; the sutural edge is thickened, and bordered by two closely set, undulating, sharp, raised lines; the last whorl contracts somewhat suddenly in front and terminates in a short, rather wide, and curved canal, slightly bent backwards at the anterior extremity. The spiral lines are unequal, thick prominent lines alternating with very slender, thread-like lines; the larger lines are granulated with much regularity by the successive margins of the outer lip; the smaller lines are but faintly decussated. The aperture is rather widely oval; the outer lip slightly arched and sinuated at the shoulder; the sinus very wide, moderately deep, and triangular in form; and the columella, which is a little twisted, presents a small crest in front.

This species presents an elegant ornamentation, quite distinct in character from that of any other English Eocene Pleurotoma. It appears to be exceedingly rare.

Size.—Axis, 11-12ths of an inch; diameter, 4-12ths of an inch, nearly.

Locality.—Barton.

No. 232. PLEUROTOMA ACUTISINUATA. *F. E. Edwards.* Tab. XXXII, fig. 5, *a*, *b*.

P. testâ elongato-fusiformi, gracili, sub-turritâ, acuminatâ, undique spiraliter lineatâ: anfractibus convexiusculis, ad humeros angulatis, postice declivis, concavis; lineis spiralibus confertis, irregularibus: aperturâ sub-quadratâ, in canali brevi exeunte; labro paululum arcuato; sinu ad humerum collocato, latissimo, minime profundo, trigono, ad apicem acute angulato.

Shell slender, oblong-fusiform, somewhat turreted, and ornamented with concentric, raised lines, which cover the whole surface; spire pointed, elevated, exceeding the aperture in length. The whorls, seven or eight in number, are depressedly convex at the sides, and sharply angulated, almost keeled, at the shoulders; and the posterior margins which slope gently backwards, are slightly channeled and girt by a single raised line round the suture. The spiral lines are close-set, threadlike, equal,

and regular on the posterior margins and shoulders; over the middle of the whorls four or five thicker and coarser lines appear, between which finer lines intervene; and over the front of the last whorl and the canal the lines again become close-set, equal, and regular; the whole are roughened, those over the margins almost decussated, by the lines of growth. The aperture is subquadrate, and terminates in a short, moderately wide, and nearly straight canal; the outer lip is very slightly arched, almost straight; and the sinus, which is very wide, shallow, and pointed at the extremity, is placed on the shoulder.

The transverse lineation, associated with the acutely angular whorls and the wide, pointed sinus, distinguish this Pleurotoma from all its congeners; the species is apparently very rare.

Size.—Axis, rather more than 9-12ths of an inch; diameter, 3-12ths of an inch.

Locality.—Bracklesham Bay.

No. 233. Pleurotoma rotundata. *F. E. Edwards.* Tab. XXXI, fig. 9, *a*, *b*.

P. testâ oblongo-fusiformi, turritâ, omnino spiraliter exilissime lineatâ: anfractibus depresso-convexis, ad humeros rotundatis vel obtuse angulatis, in juventâ arcuato-crenulatis, deinde inermibus; postice sub-depressis, concavis, plicato-marginatis; ultimo anfractu in canalem longiusculum angustum producto; lineis spiralibus confertis, exilibus, inæqualibus, irregularibus: aperturâ oblongo-ovali; labro leviter arcuato, ad humerum sinuato; sinu latiusculo, mediocriter profundo, sub-semi-elliptico.

An oblong, fusiform, turreted shell, covered with very fine transverse lines; the spire is somewhat cylindrical, pointed, and produced, nearly equalling the aperture in length. The whorls, six or seven, are depressedly convex, and rounded at the shoulders, which in the young state present a close-set series of narrow, crescent-shaped plications, but which afterwards become round and simple, or occasionally are girt with a very narrow and slightly elevated, keel-like band, imparting an obscurely angulated appearance to the shoulder; the posterior margins are slightly depressed, deeply concave, and bordered round the suture by a prominent band, formed of two or three undulating, raised lines, finely plicated; the last whorl is much contracted about the middle, whence it tapers gradually towards the base, forming a moderately long and rather narrow canal. The spiral lines are very fine, even, and close-set over the posterior margins and shoulders of the whorls; over the middle and front parts they are more distant and irregular, broader and somewhat depressed lines alternating with exceedingly slender lines; and all are more or less feebly granulated by the lines of growth. The aperture is of an oblong-oval shape; the outer lip moderately arched, and the sinus, which is placed on the shoulder, is rather wide, not very deep, rounded at the extremity, and of a nearly semi-elliptical shape.

This species approaches nearly to *P. granata*; but the depressed and deeply concave margins and rounded shoulders of the whorls give a peculiar character, by which it may readily be distinguished. It also presents a close resemblance to a Pleurotoma from the upper and middle Eocene deposits of Germany, figured by Beyrich ('*Die Conchylien des norddeutschen Tertiärgebirges*,' tab. xxix, fig. 4); but descriptions by that author of the Pleurotomæ figured by him have not been yet published, and without them, or a comparison of the shells themselves, it is unsafe to express any opinion as to the identity of the two species.

Size.—Axis, 11-12ths of an inch, nearly; diameter, rather more than 4-12ths of an inch.

Localities.—Highgate, Potter's Bar, Chalk Farm.

No. 234. Pleurotoma granata. *F. E. Edwards.* Tab. XXXI, fig. 7, *a—c.*

P. testâ oblongo-fusiformi, turritâ, undique transversim granoso-lineatâ: anfractibus depresso-convexis, ad humeros obtuse carinatis, noduloso-crenatis; marginibus posticis latis, profunde cavatis, ad suturam incrassatis, lineatis, plicatis; ultimo anfractu antice subconico, in canali lato, brevi, desinente; lineis transversis supra margines et humeros anfractuum exilibus, numerosis, regularibus; supra medias partes crassioribus, inæqualibus, lineis majoribus minoribusque alternantibus; omnino lineis incrementi elegantissime granulatis: aperturâ ob-ovatâ; labro tenui, valde arcuato; sinu lato, mediocriter profundo, ad humerum collocato; columellâ contortâ, callosâ.

A broad, fusiform shell, the whole surface of which is beautifully ornamented with finely granulated, concentric, raised lines; the spire, formed of five or six volutions exclusive of the pullus, is turreted, pointed, and moderately elevated, not quite equalling the aperture in length. The whorls are bluntly and obscurely keeled round the shoulders, on which they present a series of rather closely set, oblong, obliquely curved plications, variable in size in different specimens, and frequently lost on the last whorl; the posterior margins are wide, embracing the preceding whorls nearly up to the shoulders, deeply channeled, thickened and finely plicated round the suture, where, occasionally, they are girt with one or two raised lines more prominent than the rest. The suture itself is deep and very perspicuous, owing to the great width of the margin of the whorl. The last whorl is flatly convex and much contracted towards the front, whence it tapers nearly regularly to the base, presenting somewhat of a conical form; and the anterior canal is wide and short, but distinct. The concentric lines over the margins and shoulders of the whorl are numerous, regular, very slender, and thread-like; over the middle and front parts they are thicker and more prominent, closely set, and unequal, larger lines alternating with smaller ones; all are very regularly and closely granulated by the lines of growth. The aperture is of a wide, oval form; the outer lip thin and sharp on the edge, and much arched; the sinus, which is wide, moderately

deep, and triangular, is placed on the shoulder, and the columella is twisted, and bears a single, oblique, and obscure, fold-like callus near the middle.*

This, as well as the preceding, species presents a close analogy with a Pleurotoma from the lower Eocene deposits of Germany, figured, but not as yet described, by Beyrich ('*Norddeuts. Tertiärgeb.*,' tab. xxix, fig. 3); and for the reasons before stated, the identity cannot be satisfactorily ascertained.

Size.—Axis, 7-12ths to 9-12ths of an inch, nearly; diameter, rather more than 3-12ths of an inch, nearly 4-12ths.

Localities—Highgate, Potter's Bar.

No. 235. Pleurotoma parilis. *F. E. Edwards.* Tab. XXXI, fig. 10, *a—c.*

P. testâ oblongo-fusiformi, undique concentrice lineatâ: spirâ sub-conicâ elevatâ: anfractibus convexiusculis, ad humeros obtuse angulatis, inermibus; marginibus posticis latis, concavis, ad suturam exilissime crenulatis; ultimo anfractu sub-conico, in canalem brevem, latiusculum, prolongato; lineis concentricis confertis, supra partes anticas mediasque anfractûum inæqualibus, lineis incrementi asperatis; supra margines regularibus, granulatis: aperturâ oblongo-ovali; labro tenui, sub-semicirculari; sinu profundo, marginibus sub-parallelis, ad humerum collocato; columellâ contortâ, callosâ.

Shell elongated, fusiform, and covered with numerous, fine, concentric, raised lines; the spire, formed of seven or eight volutions exclusive of the pullus, is pointed, nearly conical, and moderately elevated, equalling the aperture in length. The whorls are slightly convex, with broad, concave margins, and are separated by a deep, well-defined suture, along the edge of which they present a series of fine crenulations, which give a wrinkled appearance to the margin; in the early whorls the margins overlap the preceding whorls up to the shoulders, but in the later whorls the shoulders are more exposed. The last whorl is nearly conical, and terminates in front in a moderately wide and short, but distinct, canal. The concentric lines are closely set; over the front and middle of the whorls they are irregular and unequal, very slender lines alternating with thicker, thread-like lines, and they are roughened, almost granulated, by the lines of growth; over the margins and shoulders, the concentric lines are even, regular, and finely granulated. The aperture is of an oblong-oval form; the outer lip is much arched, almost semicircular, thin, sharp on the edge, and smooth within, and it presents at the shoulder a wide and very deep sinus, with nearly parallel margins and a rather widely rounded extremity; the columnella is slightly twisted, and bears about the middle an obscure, oblique, fold-like callus.

* The callus on the columella of *P. granata*, *P. parilis*, and of some other shells referred to *Pleurotoma*, suggests the propriety of placing those species among the *Borsoniæ*; but this callus is not, in fact, a true fold, but merely a thickening caused by the contortion of the columella; and, therefore, the species in which it is found are carefully excluded by Bellardi from his genus.

The close resemblance which this Pleurotoma presents to *P. granata*, both in form and in ornamentation, would lead to its being regarded rather as a variety of, than as distinct from, that species; but the narrower and less concave margins, and the simple, rounded shoulders of the whorls, the more conical form of the spire and of the last whorl, and especially the deep, oblong sinus, distinguish it.

Like *P. rotundata* and *P. granata*, this species presents a close analogy with certain shells from the lower Eocene deposits of Germany, figured, but not as yet described, by Beyrich ('*Norddeutschen Tertiärgeb.*,' tab. xxix, fig. 2); but on the grounds before mentioned, it would be hasty to assume the identity of the English and German shells.

Size.—Axis, 10-12ths of an inch; diameter, 4-12ths of an inch.

Localities.—Highgate, Potter's Bar.

No. 236. Pleurotoma læviuscula. *F. E. Edwards.* Tab. XXXII, fig. 9, *a*, *b*.

P. testâ elongato-fusiformi, sub-turritâ, læviusculâ: anfractibus convexiusculis; ad humeros in juventâ tuberculatis, deinde simplicibus, postice et antice transversim lineatis, cæterum lævibus; marginibus posticis canaliculatis: aperturâ oblongo-ovali, in canali angusto, brevi, exeunte; labro leviter arcuato, tenui; sinu lato, breviusculo, sub-trigono, ad humerum collocato.

Shell elongated, fusiform, nearly smooth; the spire, formed of six or seven volutions, is rather thick and pointed, and is nearly as long as the aperture. The whorls are slightly convex, and in the early stages of growth present on the shoulders a series of close-set, oblong tubercles, which become obliterated on the third or fourth whorl, after which the shoulders are smooth; the posterior margins are ornamented by three or four concentric, raised lines; of these the one nearest the suture is sharp and ridge-like, and more prominent than the others, and immediately in front of this the margin is traversed by a rather deep, narrow channel; the other marginal lines are feeble and somewhat obscure; the middle of the whorls is smooth; the front parts and base are covered with numerous, close-set, raised lines, rounded on the upper surface; these lines are irregular and unequal, fine lines alternating with thicker ones. The aperture is of an oblong-oval form, and terminates in front in a narrow, short, but distinct canal; the outer lip is thin, smooth within, and but slightly arched; and the sinus, which is on the shoulder, is wide, not very deep, and somewhat three-cornered.

The smooth surface of this Pleurotoma is not a common character, and entitles it to specific distinction.

Size.—Axis, rather more than 7-12ths of an inch; diameter, 5-24ths of an inch.

Locality.—Brockenhurst.

No. 237. Pleurotoma turbida. *Solander.* Tab. XXXII, fig. 2, *a—c.*

Murex turbidus. *Sol.* 1766. Brand., Foss. Hanton, p. 19, fig. 31.
Pleurotoma colon. *Sow.* 1816. Min. Con., vol. ii, p. 106, t. 146, f. 7, 8.
— cataphracta. *Morr.* 1843. Cat. Brit. Foss. (1st Edit.), p. 157; (non *Brocc.*)
— colon. *Morr.* 1843. Cat. Brit. Foss. (1st Edit.), p. 157.
— turbida. *Morr.* 1843. Cat. Brit. Foss. (1st Edit.), p. 157.
— colon. *Bronn,* 1848. Index Palæont., p. 1003.
— turbida. *Bronn,* 1848. Index Palæont., p. 1011.
— colon. *D'Orb.* 1852. Prod. de Paléont., 25e Etage, p. 359, No. 409.
— turbidus. *D'Orb.* 1852. Prod. de Paléont., 25e Etage, p. 359, No. 413.
— colon. *Morr.* 1854. Cat. Brit. Foss., p. 269.
— turbida. *Morr.* 1854. Cat. Brit. Foss., p. 270.
Nec. Pleurotoma turbida. *Lam.* Encycl. Méthod., t. 451, f. 8.
Nec. — — *Lam.* Anim. sans Vert., vol. vii, p. 97, No. 5.
Nec. — colon. *Desh.* 1824-37. Coq. foss., &c., de Paris, vol. ii, p. 492, t. 66, f. 4, 7.
Nec. — — *Nyst,* 1835. Rech. coq. foss. d'Anvers, p. 28, No. 26.
Nec. — — *Nyst,* 1836. Rech. coq. foss. de Hoesselt, &c., p. 30, No. 78.
Nec. — — *De Kon.* 1837. Coq. foss. de Basele, &c. p. 20, No. 19.
Nec. — turbida. *Nyst,* 1843. Coq., &c., foss. de Belg., p. 513, t. 40, f. 8.
Nec. — — *Grat.* 1847. Conch. foss., &c., de l'Adour, Atlas, t. 3, No. 21, f. 26.

P. testâ oblongâ, sub-fusiformi, turritâ, undique concentrice lineatâ: spirâ elevatâ, obtusâ: anfractibus depresso-convexis ad humeros in juventâ carinam obtusam crenatam transversim sulcatam, gerentibus, deinde curvo-plicatis; marginibus posticis concavis, ad suturam scabro-plicatis et duabus vel tribus lineis elevatis, acutis, cinctis; ultimo anfractu sub-conico; lineis concentricis supra margines et humeros anfractuum confertis, exilissimis, sub-æqualibus; supra medias partes nonnullis crassis, prominentibus, fastigiiformibus, distantibus, cæterum exilibus; omnino sub-clathratis: aperturâ elongato-ovali, in canali brevissimo, ad basin profunde emarginato, exeunte; labro tenui, sub-semicirculari; columellâ contortâ, callosâ, cristatâ; sinu latiusculo, profundo, marginibus sub-parallelis, ad humerum collocato.

Var. β *testâ anfractibus ad humeros fortiter tuberculatis; lineis concentricis medianis et anticis sub-denticulatis.*

Shell oblong, sub-fusiform, turreted, concentrically ridged and lined; spire rather thick, pointed, and much elevated, forming nearly 3-5th parts of the entire length. The whorls, nine or ten without the pullus, are depressedly convex; in the young state they present round the shoulders an obscure, obtuse keel, bearing a closely set series of narrow, vertical, slightly curved tubercles, defined at each end, and occasionally also traversed by fine, raised, thread-like lines; these tubercles and the keel gradually become less prominent as the shell enlarges, and frequently altogether disappear on the last two or three whorls, which then present only a series of numerous very fine, thread-like, curved plications, formed by the successive, rounded extremities of

the sinus; the posterior margins are rather deeply channeled, and are thickened round the suture, where they are girt by two or three fine, raised lines, decussated by numerous, rather coarse plications. The concentric lines in the hollow part of the margins and over the shoulders are numerous, slender, sharp, and regular; over the middle and front parts of the whorls rise several prominent, rather thick, ridge-like lines, varying in number and thickness in different individuals; and over the intermediate spaces two or three fine, thread-like lines are generally found, although in some specimens, in which the ridges approach more closely, these intermediate lines are wanting; all the lines are decussated by the sharp, perspicuous lines of growth giving a finely reticulated aspect to the surface of the shell. The aperture is of a long, narrow-oval shape, and terminates in front in a wide, very short, and indistinct canal, deeply notched at the extremity; the outer lip is almost semicircular, thin, sharp on the edge, and smooth within; the inner lip is rather thick, projecting, and curved outwards at the anterior extremity; the columella is very slightly twisted and bears, about the middle, a single, obscure, fold-like callus; the front part presents a strongly marked crest, due to the anterior notch. The sinus is placed on the shoulder of the whorl, and is deep and moderately wide, with nearly parallel margins.

The present species is very variable in the ornamentation; the most common and most strongly marked variety (*Var.* β) is the one figured in 'Mineral Conchology' (tab. cxlvi, fig. 8), in which the tubercles on the shoulders are prominent and without the transverse furrow found in the typical form; and the concentric lines over the middle and front parts of the whorls are obscurely denticulated.

The shells figured and described by Sowerby as *P. colon* are, as that author suggested, the young of Solander's species. In the young state the proportions of the spire and of the body whorl are nearly equal, and the character of the ornamentation on the shoulders of the whorls is more strongly marked; and in the figure given by Brander, *P. turbida* is represented as having a wider shell and a more pointed and slenderer spire than, in fact, characterise the species. Without an examination of the shell in all stages of growth, therefore, a doubt of the identity might reasonably be entertained.

The shell described by Lamarck as *P. turbida*, in forgetfulness, probably, of that name having been already used by Solander, is a Sub-Apennine shell, which had already been named *Murex cataphractus* by Brocchi; and this circumstance may have led to the English shell having been at one time referred to Brocchi's species, from which, however, it is quite distinct.

Deshayes also has referred to *P. colon* some shells from the Soissonnais, which, although presenting a close resemblance to the present species, are specifically distinct; the prominent and strongly crenulated band round the suture of those shells, resembling that found in *P. alligata*, is quite different in character to the margination in *P. turbida;* and although the crenulation on the shoulders of the whorls resembles that which is found in the present species, it may have arisen from some variation of

form in the animal, and is not due, as in *P. turbida*, to the successive terminations of the sinus, which in the French shells is placed in the margin of the whorl, and not on the shoulder, as in this species. These two shells, therefore, cannot, with propriety, be referred to the same species; and D'Orbigny has in fact distinguished the French shells by the specific name *pseudo-colon*.

The shells from Basele, Boom, Schelle, and Antwerp, referred in the first instance by Nyst, and afterwards by De Koninck, to *P. colon*, are also specifically distinct, and have been subsequently separated by Nyst, under the name of *P. crenata*.

There still remain to be noticed certain shells from Vliermael and Lethen; these, in the first instance, were also referred by Nyst to *P. colon;* but that author, in his description of the fossils of Belgium, has erroneously considered *P. colon* of Sowerby as specifically distinct from *P. turbida* of Solander, and has treated the shells in question as belonging to *P. turbida*. I have not seen any specimens of the Vliermael and Lethen shells; but, judging from the specimen figured in Nyst's work, apparently a full-grown shell, I do not consider that it has been correctly referred to the present species; the spire is shorter and more conical, the whorls are more convex, the posterior margins wider and less depressed, and the sutural edges not thickened nor girt by the prominent, raised lines found in the present species; the tubercles on the shoulder are much less prominent, the body whorl is contracted in front into a narrow, somewhat lengthened, canal, the outer lip is not so much curved, and the sinus is apparently triangular and much wider and shallower.

Size.—Axis, 1 inch and 11-12ths; diameter, rather more than 7-12ths of an inch.

Localities.—Barton and Highcliff, at both of which places it is very common. In Morris's catalogue, Highgate is also given as a locality for *P. colon;* but I am not aware of the present species having been found there.

No. 238. Pleurotoma ligata. *F. E. Edwards.* Tab. XXXII, fig. 12 *a*, *b*.

P. testâ scabrâ, elongato-turbinatâ, sub-fusiformi, concentrice fasciolis crassis, quasi funiculis, ligatâ: anfractibus convexiusculis, ad humeros curvi-crenatis; marginibus posticis latis, transversim tenuiter lineatis, et sulco profundo exaratis, ad suturam incrassatis, longitudinaliter crasse plicatis; ultimo anfractu conoideo, in canalem latum, brevem, ad basin paululo emarginatum, producto; fasciolis concentricis crassis, præeminentibus, sub-distantibus, rotundatis, interstitiis sub-planis: aperturâ oblongo-ovali; labro valde arcuato, acuto: sinu latiusculo, profundo, marginibus parallelis, ad humerum collocato; columellâ contortâ sub-callosâ, antice cristatâ.

Shell rugged, elongated, fusiform, and ornamented with thick, rounded bands, as if bound with cords; the spire, formed of eight or nine volutions, is nearly conical, and moderately elevated, being as long as the aperture. The whorls present round the

shoulders a series of slightly curved, irregular crenulations, more or less closely set in different specimens; the posterior margins are very wide, covering the preceding whorls up to the shoulders; they are deeply channelled, and much thickened round the sutural edge, so as to form a broad, elevated band, which is crossed by numerous narrow, vertical plications, corresponding with the crenulations on the shoulders; the whole surface of the margins, and also the shoulders, are covered with fine, concentric, raised lines, which are most prominent over the sutural band; the body whorl is flatly convex, nearly conical, and terminates in front in a wide, short, but distinct canal, rather deeply notched at the anterior extremity. The concentric bands are thick and very prominent, rounded on the upper surface, and rather distant; the intervening spaces are flat, and traversed, in some specimens, by one or more thread-like raised lines, and in others by flattened bands, similar in character to the principal bands, but much narrower and less prominent. The aperture is of an oblong-oval form; the outer lip much arched, almost semicircular, thin and sharp on the edge, and smooth within; the sinus, which is placed on the shoulder, is deep and not very wide, with nearly parallel margins; and the columella is slightly twisted, and presents near the middle an obscure callus.

This strongly marked species is, I believe, peculiar to Bramshaw; at least I have not met with it elsewhere. In its general aspect and the character of the ornamentation, it strongly resembles the Soissonnais shells referred by Deshayes to Solander's *P. colon;* but, as I have already pointed out, the sinus in those shells is placed in the marginal furrow, and not on the shoulder, as in the present species.

Size.—Axis, rather more than $1\frac{1}{2}$ inch; diameter, 7-12ths of an inch.

No. 239. Pleurotoma hemileia. *F. E. Edwards.* Tab. XXXII, fig. 13, *a, b.*

P. testâ fusiformi, utrinque sub-conicâ, transversim fasciolatâ: anfractibus ad humeros obtuse angulatis, in juventâ plicatis, deinde lævibus; antice planulatis, postice declivis, paulo concavis, ad suturam concentrice lineatis; cæterum lævibus; fasciolis transversis sub-distantibus, parum elevatis, interstitiis concavis; ultimo anfractu ad basin emarginato: aperturâ angustâ, sub-quadratâ, in canali patulo, indistincto, exeunte; labro leviter arcuato; sinu ad humerum collocato, lato, profundo, marginibus sub-parallelis; columellâ leviter contortâ.

Shell fusiform, rather narrow, presenting somewhat of the appearance of two cones placed base to base, transversely furrowed and banded, but with the surface smooth and shining: the spire, formed of seven or eight volutions, is elevated, equalling the aperture in length. The whorls are obtusely angulated at the shoulders, round which, in the very young state, they present a series of regular, closely set, long, narrow, vertical plications, which gradually become more and more faint as the shell is enlarged, and ultimately disappear on the fourth or fifth whorl, after

which the shoulders are without ornament; the sides of the whorls in front of the shoulders are very nearly straight; the posterior margins slope gently backwards, and are very slightly channelled. The sutural edge presents either a single, sharp, ridge-like line, or, more generally, two sharp and very slender, raised lines, separated by a concave furrow; in the early whorls it is strongly crenulated, but the crenulations afterwards become faint and almost obsolete; the hollow space between the margin and the shoulder, and the shoulders themselves in the later whorls, are smooth and shining. The concentric bands are depressed, more or less broad in different specimens, and separated by rather deep, concave furrows, which are frequently traversed by a single, very fine, raised line. The last whorl, which is nearly conical, is slightly notched at the base and feebly crested in front. The aperture is narrow, long, and sub-quadrate, and terminates in front in a wide, short, indistinct canal; the outer lip is moderately arched, thin-edged, and smooth within; the sinus is wide and deep, with nearly parallel margins, and is placed on the shoulder; and the columella is cylindrical and very slightly twisted.

This Pleurotoma has a close analogy with *P. turbida*, for which, in the young state, it may be mistaken; but the greater narrowness, and the smooth, shining surface, of the shell, the more conical form as well of the spire as of the body whorl, the unornamented shoulders of the later whorls, and the narrow, subquadrate aperture, sufficiently distinguish it from that species.

Size.—Axis, 1 inch and 2-12ths, nearly; diameter, rather more than 5-12ths of an inch.

Locality.—Alum Bay (Stratum No. 29, Prestw.)

No. 240. Pleurotoma Hantoniensis. *F. E. Edwards.* Tab. XXXI, fig. 8, *a—c.*

Pleurotoma plebeia, var. *b. Forbes.* 1856. Tert. fluvio-mar. form., &c. (Mem. Geol. Surv.), p. 154, t. 5, f. 2.

P. testâ turritâ, transversim lineis elevatis crassis cinctâ: spirâ acuminatâ: anfractibus depresso-convexis, cariná obtusâ, nodoso-crenatâ, bipartitis; marginibus posticis sub-depressis, excavatis, transversim exilissime lineatis, ad suturam crenulatis; ultimo anfractu antice valde coarctato, in canalem patulum, ad extremitatem emarginatum, producto; lineis transversis supra medias partes anfractuum crassis, præeminentibus, sub-distantibus, irregularibus; interstitiis sæpe exiliter lineatis: aperturâ oblongo-ovali; labro tenui, simplici, valde arcuato: columellâ contortâ, obscure callosâ; sinu latiusculo, triangulari, ad carinam collocato.

Shell turreted, concentrically and coarsely lined: spire pointed, elevated, a little exceeding the aperture in length. The whorls, eight or nine exclusive of a smooth, conical pullus, are depressedly convex, divided unequally at the shoulder by an obtuse

keel, bearing a row of moderately distant, nodulous tubercles; the posterior margins are depressed, concave, bordered round the suture by two sharp, elevated lines, crenulated by the lines of growth; the hollow space between these lines and the shoulder is traversed by numerous very slender lines, so fine as scarcely to be visible without the aid of a magnifying glass or to detract from the otherwise smooth aspect of the surface; the concentric lines over the middle of the whorls are very prominent, thick, cord-like, rather distant, and irregular; two or three fine, thread-like lines very often appear in the intervening spaces. The last whorl is much contracted towards the front, and terminates in a short, distinct, and very wide canal, rather deeply notched at the anterior extremity. The aperture is of an elongated, oval form; the outer lip much arched, thin and sharp on the edge, and smooth within; the sinus, which is placed on the keel, is very wide, moderately deep, and triangular in shape; and the columella is slightly twisted, and presents about the middle a very obscure callus, and at the anterior extremity the crest, which usually accompanies a well-defined, anterior notch.

This Pleurotoma is, as Professor E. Forbes (*loc. cit.*) has observed, much thicker, wider, and larger than *P. plebeia* (*denticula*), of which, nevertheless, from an assumed identity of sculpture in all essential points in both shells, that author considered it to be merely a variety. In this opinion I cannot concur. Without attaching too much weight to the great differences in the size and relative proportions of the two shells, although, when associated with other distinctions, these are not without importance, it will be seen that, in fact, the sculpture is not identical with that of *P. denticula*, and that there are other dissimilarities sufficient to separate the present Pleurotoma from that species. With regard to the crenulation on the shoulders of the whorls, that character is due, as before observed, to the thickening of the shell at the extremity of the sinus, and a greater or less similarity in that ornament must necessarily prevail in all the species forming the group to which the Pleurotomæ in question belong; but in this species, the crenulations are more transversely oblong and nodulous than those which characterise the upper Eocene forms of *P. denticula;* the spire also is more pointed and shorter, the posterior margins more depressed, the transverse lineation much more coarse and prominent, and the anterior canal shorter and wider, and deeply notched at the extremity. On these grounds, therefore, I have separated the present species from *P. denticula*, although I have much hesitation in dissenting from the opinion of Professor E. Forbes. I may add that I possess a series of each form from the same locality, Lyndhurst, in which the distinguishing characters of the two species are constantly maintained, without the occurrence of any intermediate form.

Size.—Axis, 1 inch and 8-12ths; diameter, 8-12ths of an inch.

Localities.—Brockenhurst, Lyndhurst, Roydon, and Whitecliff Bay (fide Forbes).

No. 241. Pleurotoma zonulata. *F. E. Edwards.* Tab. XXXII, fig. 6, *a*, *b*.

P. testâ parvâ, elongato-fusiformi, sub-turritâ, omnino concentrice lineatâ: anfractibus depresso-convexis; marginibus posticis sulcatis; ultimo anfractu sub-conico, in canali lato brevi terminato; lineis concentricis crassiusculis, per-elevatis, sub-distantibus: aperturâ ovali; labro sub-recto, acuto, intûs plicato; sinu lato, profundo, sub-trigono, ad humerum collocato.

Shell small, elongate, fusiform, and concentrically lined; the spire is elevated, exceeding the aperture in length, and somewhat turreted; the whorls are flatly convex, and furrowed round the posterior margins, the sutural edge of which is bordered by a single prominent line; the last whorl is nearly conical, and terminates, anteriorly, in a very wide, short, but distinct and oblique, canal; the concentric lines are rather thick, much elevated, moderately distant, and nearly equal over the whole surface. The aperture is of a widely ovate form; the outer lip nearly straight, thin and sharp on the edge, and plicated within; the sinus is placed on the shoulder, and is very wide, deep, and sub-trigonal in shape, with a much-rounded apex; and the columella is slightly twisted.

A very pretty and somewhat rare shell, the prominent and nearly equal transverse lineation of which gives to it a screw-like appearance. It appears to be quite distinct.

Size.—Axis, 4-12ths of an inch; diameter, 1-8th of an inch.

Localities.—Highcliff, Barton, Alum Bay (Stratum, No. 29, Prestw.)

No. 242. Pleurotoma conoides. *Solander.** Tab. XXXIII, fig. 5, *a*, *b*.

Murex conoides. *Sol.* 1766. Brand., Foss. Hanton, p. 14, fig. 17.
— — *Morr.* 1854. Cat. Brit. Foss., p. 270.
Non. Pleurotoma conoidea. *Nyst*, 1843. Descr. des coq., &c., de Belg., p. 515, t. 40, fig. 9.

P. testâ utrinque sub-conicâ, sub-turritâ, longitudinaliter denticulato-plicatâ, concentrice lineatâ: spirâ elevatâ, acuminatâ; anfractibus ad humeros acute angulatis, marginibus posticis declivis, valde cavatis, ad suturam unicâ lineâ, aliquando fastigiiformi, aliquando

* The descriptions of this and the following two species, *P. biconus* and *P. helicoides*, have been, accidentally, misplaced; the species form part of the first section, in which the sinus is placed in the margin of the whorls.

denticulatá, cinctis, cæterum lævibus; ultimo anfractu conico, antice in canali patulo indistincto, terminato, ad basin emarginato: aperturá angustá, sub-quadratá; labro arcuato, acuto, intús plicato; sinu latiusculo, sub-semicirculari, in margine collocato.

Shell fusiform, somewhat turreted, longitudinally plicated, and transversely lined; the spire conical, pointed, elevated, forming rather more than half of the shell. The whorls are sharply angulated at the shoulders; the posterior margins slope gently backwards; they are deeply channelled, and are bordered round the suture by an elevated line, which, in some specimens, is sharp and ridge-like, in others denticulated; the hollow space between this line and the shoulders is smooth; the last whorl is nearly conical, and terminates in front in a wide, indistinct canal, slightly emarginate at the extremity; this form of the body whorl, with the conical spire, imparts to the shell the appearance of two cones placed base to base. The longitudinal plications, which extend to the very base of the shell, are numerous, narrow, oblique, curved, and thickened at the points, where they are crossed by the transverse lines, into small, tooth-like tubercles; the transverse lines are moderately distant and sharp. The aperture is very narrow and subquadrate, resembling that of the cones; the outer lip is moderately arched, sharp-edged, and strongly plicated within; the sinus, which is placed in the margin, is rather wide and nearly semicircular.

Some shells from Lethen and Vliermael have been referred by Nyst to this species, although with doubt; judging from the figure given by that author, the margins of the whorls in those shells appear to be narrower, and the longitudinal plications thicker and less numerous, than in this species, and the body whorl is convex, contracted in front, and terminates in a perspicuous canal; the shells in question are, in fact, quite distinct from the "*testa ecaudata, utrinque sub-conica*," described by Solander, and D'Orbigny has distinguished them as *P. sub-conoides.*

Size.—Axis, 9-12ths of an inch; diameter, nearly 4-12ths of an inch.

Localities.—Barton, Highcliff, Alum Bay (No. 29, Prestwich).

No. 243. Pleurotoma biconus. *F. E. Edwards.* Tab. XXXIII, fig. 7, *a*, *b*.

P. testá biconicá, concentrice lineatá: spirá sub-turritá, acuminatá: anfractibus ad humeros angulatis, granoso-tuberculatis; postice cavatis, ad suturam lineá fastigiiformi cinctis, cæterum lævibus; antice sub-rectis: lineis concentricis elevatis, acutis, sub-distantibus, interstitiis concavis: aperturá angusto-ovali, in canali patulo indistincto exeunte; labro leviter arcuato, acuto, intús plicato; sinu lato, breviusculo, sub-trigono, in margine collocato.

Shell doubly cone-shaped and concentrically lined; the spire, which is a little shorter than the aperture, is somewhat turreted and pointed. The whorls, five or six without the pullus, are rather sharply angulated at the shoulders, which present

a series of very small, closely set, regular, rounded tubercles, frequently lost on the last whorl of the adult shell; the posterior margins are channelled and bordered round the suture by a single elevated, sharp, ridge-like line, the space between which and the suture is smooth; the body whorl is nearly straight-sided, and tapers gradually towards the front, assuming a nearly conical shape, and it terminates in a wide and indistinct canal, slightly notched at the extremity. The aperture is narrow, and of an oblong-oval shape; the outer lip very slightly arched, thin and sharp on the edge, and plicated within; and the sinus, which is wide, very shallow, and sub-trigonal in form, is placed in the margin of the whorl.

This Pleurotoma, in its general aspect, presents a very close analogy with *P. conoides*, of which, on a cursory inspection, it might be regarded as a variety merely. It is, however, a broader shell, the spire is not so much produced, and the sculpture consists of simple, transverse lineation, without the denticulated, longitudinal plication which distinguishes that species; the outer lip also is much less arched, and the sinus is wider, shallower, and more triangular.

Size.—Axis, 7-12ths of an inch; diameter, 3-12ths of an inch.

Locality.—Highcliff.

No. 244. Pleurotoma helicoides. *F. E. Edwards.* Tab. XXXII, fig. 7, *a*, *b*.

Pleurotoma turrella. *Morr.* 1854. Cat. Brit. Foss., p. 270 (non *Lam.*).

P. testâ elongato-fusiformi, angustâ, transversim lineatâ: spirâ elevatâ, sub-conicâ, acuminatâ: anfractibus numerosis, ad humeros et prope suturam bi-carinatis; marginibus posticis latiusculis, paululo declivis, sub-rectis; ultimo anfractu brevi, convexiusculo, in canali patulo indistincto exeunte, ad extremitatem profunde emarginato; lineis transversis omnino lineis incrementi eleganter clathratis; suprâ margines posticas crebis, exilissimis, regularibus; cæterum elevatis, acutis, irregularibus: aperturâ angusto-ovali; labro arcuato; sinu lato, brevi, triangulari, anticâ in margine collocato.

Shell long, narrow, fusiform, transversely lined: the spire nearly conical, pointed, and much elevated, being almost twice the length of the aperture. The whorls, nine or ten in number, present a narrow, elevated keel round the shoulders, and a sharp, raised, ridge-like line, like a second keel, round the edge of the whorls, at a little distance from the suture; these keels give to the spire a screw-like appearance; in the early whorls the keel on the shoulders is transversely denticulated. The posterior margins, which slope but slightly backwards, are wide, covering the preceding whorl up to the shoulder, and are very obscurely channelled, almost straight; the last whorl is short, convex, and produced in front into a wide and somewhat indistinct canal, deeply notched at the extremity. The concentric lines over the margins are rather

close-set, regular, and very slender; over the middle and front parts of the whorls they are sharp, rather distant, unequal and irregular, slender and slightly raised lines alternating with other lines thicker and more prominent; all are beautifully decussated by the prominent lines of growth. The aperture is of a narrow, oval form; the outer lip moderately arched, thin and sharp on the edge, and smooth within; the sinus, which is wide, short, and triangular, is placed in the front of the margin, the apex being immediately behind the keel; and the columella is slightly twisted, and crested in front. In the specimens from Highcliff the shell is comparatively wider, with a shorter spire, but the sculpture is identical.

This Pleurotoma presents a close resemblance to *P. turrella* (Lamk.) from the Calcaire Grossier, with which, in fact, I had formerly associated it; but a careful examination of a larger series of specimens than I then possessed has induced me to change that opinion. In the French species the shell is smaller, the spire much less produced, the whorls more convex, the posterior margins more slanting, the body whorl more conical, the keel on the shoulder not so prominent, the transverse lineation more crowded and less bold and decided in character, and the sinus narrower, deeper, and placed in the middle of the margin. The English shells present altogether a character so distinct, that I am unwilling to regard them even as varieties of Lamarck's species.

Size.—Axis, 15-24ths of an inch (16 millim.); diameter, not quite 5-24ths (5 millim.).

Localities.—Barton and Highcliff, at both of which places it is somewhat rare, but rather less so at the latter locality.

Section II.—*Shells coniform.*

No. 245. PLEUROTOMA PRISCA. *Solander.* Tab. XXXIII, fig. 1, *a*—*e*.

MUREX PRISCUS. *Sol.* 1766. Brander, Foss. Hanton, p. 16, f. 25 and 44.
PLEUROTOMA CLAVICULARIS. *Lamk.* 1802. Ann. du Mus., vol. iii, p. 165, No. 3.
— — *Roissy*, 1804. Buffon, Moll., vol. vi, p. 73.
— — *Lamk.* 1816. Tab. Encyclop. et Méthod., t. 440, f. 4.
— — *Lamk.* 1822. Anim. sans Vert., vol. vii, p. 98.
— PRISCUS. *Sow.* 1823. Min. Con., vol. iv, p. 119, t. 386.
— CLAVICULARIS. *Brongn.* 1823. Terr. tert. du Vicent., p. 73.
— — *De. Blainv.* 1826. Dict. des Sci. nat., vol. xli, p. 388.
— PRISCA. *De Blainv.* 1826. Idem.
— — *Bronn*, 1831. Ital. Tertiärgeb., p. 47, No. 321.

PLEUROTOMA CLAVICULARIS. *Desh.* 1832. Encyclop. Méthod. (Vers.), vol. iii, p. 796, No. 12.
— — *Desh.* 1824-37. Coq. foss., &c., de Paris, vol. ii, p. 437, t. 69, f. 9, 10, and 15–18.
— PRISCA. *Desh.* 1824-37. Idem, vol. ii, p. 436, t. 69, f. 1, 2.
— CLAVICULARE. *Phil.* 1846. Tert. foss. Magdeburg, p. 63, No. 113.
— CLAVICULARIS. *Bronn,* 1848. Index Palæontol., p. 1002.
— PRISCA. *Bronn,* 1848. Idem, p. 1008.
— CLAVICULARIS. *Rouault,* 1848. Foss. du térr. éoc., &c., de Pau (Mém. Soc. Géol. de France, 2d ser., vol. iii, p. 481), No. 83.
— PRISCA. *Sow.* 1850. Dixon's Geol., &c., of Sussex, p. 102, t. 7, fig. 24; and p. 119, t. 14, fig. 30.
— — *Bell.* 1851. Foss. Nummul. du Comté de Nice (Mém. Soc. Géol. de France, 2d ser., vol. iv, p. 222), No. 86.
— CLAVICULARIS. *Bell.* 1851. Idem, No. 87.
— — *D'Orb.* 1852. Prod. de Paléontol., vol. iii, p. 359; 25^{e} Etage; Parisien, A, No. 404.
— PRISCA. *D'Orb.* 1852. Idem, vol. iii, p. 416; 25^{e} Etage; Parisien, B, No. 1475.
— CLAVICULARIS. *Nyst.* 1836. Coq. foss. de Hoesselt, &c., p. 31, No. 79.

P. testâ elongato-fusiformi, sub-glabrâ: spirâ elatâ, sub-conicâ, acuminatâ: anfractibus ventricosis, postice lineato-marginatis, ad basin transversim sulcatis, cæterum lævibus; ultimo anfractu in canali lato, indistincto, exeunte, ad extremitatem sub-profunde emarginato: aperturâ oblongo-ovali; labro aliformi, tenui, acuto; sinu lato, breviusculo, sub-trigono, anticam in marginem collocato; labio antice incrassato, reflexo: columellâ leviter contortâ, antice cristatâ.

Shell elongated, fusiform, nearly smooth; the spire almost conical, pointed, and moderately elevated, being of equal length with the aperture. The whorls are slightly ventricose; when young, the whole surface is covered with moderately distant, concentric, raised lines, in which state it resembles *P. filosa* (Lamk.); these lines, however, are lost on the fourth or fifth volution, and the whorls afterwards become smooth and shining, except at the base and over the posterior margins, round the sutural edges of which last run three or four fine threadlike, raised lines, occasionally replaced by two or three shallow, obscure furrows; the last whorl is nearly conical, obscurely sulcated at the base and deeply notched at the extremity; the anterior canal is wide, very short, and indistinct. The aperture is narrow and of an oblong-oval form; the outer lip wing-shaped, projecting towards the front, thin and sharp on the edge, and smooth within; the sinus, which is in the very front of the margin, is wide, moderately deep, somewhat triangular in form, and widely rounded at the extremity; the inner lip is much thickened, and is produced and bent outwards in front, giving an umbilicated appearance to the columella, which is slightly twisted and prominently crested towards the base.

It appears to me to be impossible, satisfactorily, to separate *P. clavicularis* from

the *P. prisca* of Solander. It is true that in Lamarck's species the shell is smaller and narrower, the spire more tapering, the whorls not so ventricose, and the sinus rather wider and shallower; but whether these differences, even when constant, are by themselves of specific value may be questionable: and it must be stated that the English shells are variable in the length of the spire and the condition of the whorls, which, in some specimens, are less convex than in others, and, in fact, I have, in my collection, a Barton specimen which, so far as the proportions and shape of the shell may be relied on, cannot be regarded as specifically distinct from *P. clavicularis*. The only distinction to which, apparently, any consideration is due, lies in the condition of the sinus. In the shell figured by Deshayes as *P. prisca*, the sinus is represented as placed in the front of the margin with the apex almost on the shoulder, and as being deep and rather narrow, with nearly parallel margins; now, this does not correspond with the sinus in Solander's species, which, although similarly placed, is intermediate in form between the sinus in *P. prisca* of Deshayes and that in *P. clavicularis*. I have already suggested that the sinus may be, reasonably, expected to be liable to variation in its dimensions, and too much importance, therefore, must not be attributed to mere differences in size and proportion. On these grounds, I have, notwithstanding the array of authorities against me, considered *P. clavicularis* of Lamarck as merely a variety of Solander's species.

Size.—Axis, 2 inches and 11-12ths (74 millim.); diameter, 11-12ths of an inch (23 millim.) The specimen represented by fig. 1 *d*, is upwards of 3 inches in length; but the body of the shell having been twice broken and repaired by the animal, the diameter cannot be accurately stated.

Localities.—Barton, Highcliff, Bramshaw, Stubbington, Bracklesham Bay. *French:* Grignon, Parnes, Mouchy, Courtagnon, Valmondois, Acy, Tanerou (fide Desh.), Cuisse-Lamotte, Marquemont, Saint Félix, Gomerfontaine, Les Groux, Hermes, Châteaurouge, Mouy, Monneville, Neuvillebosc (fide Graves), Bos d'Arros (fide Rouault). *Italian:* Palarea (Nice), (fide Bellardi), Montecchio-Maggiore on the Vicentin (fide Brongniart).

No. 246. PLEUROTOMA AMPHICONUS. *Sow.* Tab. XXXIII, fig. 2, *a*, *b*.

PLEUROTOMA AMPHICONUS. *Sow.* 1850. Dixon's Geol., &c., Sussex, p. 183, t. 8, f. 7 and 8.

P. testâ glabrâ, angulo obtuso inæqualiter bipartitâ, utrinque conicâ; anfractibus postice et antice undulato-sulcatis, cæterum lævibus: aperturâ angustâ, marginibus sub-parallelis, in canalem brevem, ad extremitatem profunde emarginatum, productâ; labro arcuato, ad humerum late breviterque sinuato; labio antice producto, reflexo; columellâ cristatâ.

Shell nearly smooth, obtusely angulated at the shoulders, presenting the appearance

of two unequal cones placed base to base, the smaller one of which is represented by the spire; the whorls, seven or eight without the pullus, are straight on the sides and taper regularly towards the base; the posterior margins slope gently backwards, concealing the preceding whorl up to the angle of the shoulder, giving a straight-sided, conical shape to the spire, which forms about two fifths of the entire length of the shell. Two or three narrow, obscure furrows traverse the space between the suture and the shoulders; and the front of the last whorl also presents numerous transverse, undulating furrows, the ridges between which are a little roughened by the lines of growth; the remaining surface of the whorls is smooth and shining. The aperture is long and narrow, with nearly parallel margins, resembling that of a *Cone*, and terminates in front in a wide, short, and indistinct canal, deeply notched at the anterior extremity. The outer lip is much arched, and presents on the shoulder a very wide, shallow sinus, with a broadly rounded apex; the inner lip is elevated and bent outwards at the base, giving an umbilicated appearance to the front of the shell; and the columella is cylindrical and strongly crested.

The present species is distinguished by the inequality of the two cones of which it appears to be formed, and by that character and by the wide, shallow sinus it may be easily separated from *P. prisca*, which, in other respects, it resembles. It does not appear to have an analogue among the French coniform Pleurotomæ.

Size.—Axis, $2\frac{1}{2}$ inches; diameter, 1 inch.

Locality.—Bracklesham Bay, to which it appears to be peculiar. I have not met with it elsewhere, not even at Stubbington or Bramshaw.

No. 247. Pleurotoma semistriata. *Deshayes.* Tab. XXXIII, fig. 3 *a*, 3 *b*.

Pleurotoma semistriata. *Desh.* 1824-37. Desc. des Coq. foss., &c., vol. ii, p. 443, t. 69, figs. 5, 6.

Non Pleurotoma semistriata. *Partsch.* 1837. v. Hauer. Vorkomm. foss. Thierr. tert. Beck. v. Wien; Jahrb., p. 419, No. 107.

P. testâ biconicâ, transversim obsolete lineatâ; spirâ elatâ, acuminatâ; anfractibus convexiusculis, postice obsolete sulcatis; ultimo anfractu gradatim attenuato, conoideo, concentrice distanter et exilissime lineato, antice transversim sulcato, ad basin sub-profunde emarginato: aperturâ elongato-angustâ; labro acuto, aliforme, arcuato; sinu lato, triangulari, in margine collocato.

Shell elongated, fusiform, tapering gradually towards each extremity and presenting the appearance of two cones placed base to base; the spire moderately elevated, nearly equalling the last whorl in length, and pointed. The whorls, seven without the pullus, are slightly convex, smooth and shining; the posterior margins, which slope gently backwards, present two or three very shallow, nearly obsolete, concentric furrows; the last

whorl is obscurely angulated at the shoulder, and tapers gradually and equally towards the base; it presents, in front, several shallow, obliquely transverse furrows, which become more and more feeble as they ascend towards the middle of the whorl, where they are replaced by some distant, very slender, scarcely perceptible, raised lines; the anterior canal is wide, indistinct, and rather deeply notched at the extremity. The aperture is of a long, narrow, oval shape; the outer lip much arched, projecting a little towards the anterior extremity; the sinus, which is placed in the margin, is wide, moderately deep, and triangular in form; the columella is cylindrical and slightly oblique; and the columellar lip is elevated and bent outwards, imparting somewhat of an umbilicated character to the base of the shell.

Although presenting a close analogy with *P. prisca*, this Pleurotoma is more symmetrical in its outline; the last whorl is more regularly conical, and the sinus wider, shallower, and more trigonal; these differences and the delicate, transverse lineation, confined to the middle and upper parts of the whorls, apparently separate the present species from Solander's.

The shells from Baden, to which Partsch gave the specific name *semistriata*, are fusiform, costellated shells, sharply angulated at the shoulders, and having depressed, concave margins; they are referred to by D'Orbigny, in his 'Prodrome,' as *P. sub-semistriata*, while some shells from Tortona, which Bellardi has regarded as also belonging to Partsch's species, have been named by him *P. Lamarcki*.

Size.—Of the specimen figured, axis, rather more than 11-12ths of an inch, (24 millim.); diameter, 4-12ths of an inch (9 millim.)

Localities.—Bramshaw. *French:* Parnes, Mouchy (fide Deshayes), Gomerfontaine, Gypsevil, Amblainville, Chateaurouge, Hermes, Saint Félix, Acy-en-Mulcien (fide Graves).

No. 248. Pleurotoma glabrata. *Lamarck.* Tab. XXXIII, fig. 4.

Pleurotoma glabrata. *Lamk.* 1802. Ann. du Mus., vol. iii, p. 184, No. 4.
— — *Lamk.* 1822. Anim. sans Vert., &c., vol. vii, p. 98, No. 9.
— — *Desh.* 1824-37. Descr. des Coq. foss., &c., vol. ii, p. 439, t. 69, f. 7, 8.

P. testâ utrinque sub-conicâ, sub-turritâ, glabrâ: spirâ acuminatâ, ultimo anfractu breviori: anfractibus convexiusculis, obtuse angulatis; marginibus posticis angustis, cavatis, concentrice lineatis; ultimo anfractu antice transversim sulcato, ad basin emarginato: aperturâ elongato-angustâ; labro tenui, dilatato; labio antice producto, reflexo; columellâ cylindraceâ, cristatâ: sinu lato, brevissimo, in margine collocato.

Shell doubly conical, somewhat turreted, nearly smooth; the spire pointed, moderately elevated, forming nearly two fifths of the whole length. The whorls, eight or nine

without the pullus, are slightly convex and bluntly angulated at the shoulders; the posterior margins are narrow, rather deeply channelled, very finely plicated round the suture, and ornamented with several transverse raised lines, of which the one nearest the edge is the most prominent; the whorls in front of the shoulders are smooth; the last whorl tapers gradually towards the base, and is nearly conical, and over the front part presents numerous transverse furrows, which become gradually obsolete as they mount towards the middle of the whorl; the anterior canal is wide, indistinct, and notched at the extremity. The aperture is long, narrow, with straight, nearly parallel sides, and, like that of *P. amphiconus*, resembles the aperture of a *Cone;* the outer lip is much expanded, approaching nearly to a semicircle in form, and is thin and sharp-edged; the columellar lip is thickened and produced in front; the columella is nearly cylindrical, and presents a prominent ridge or crest at the anterior extremity; and the sinus, which is placed in the margin of the whorl, is wide, but very shallow, resembling in appearance that which characterises Bellardi's section, *Pseudotomatæ*.

I possess only one specimen of this Pleurotoma; it has attained a larger size than that attributed by Deshayes to the French shells, but the relative proportions are the same in both. The transverse furrows over the base of the English shell are coarser, and extend higher up the whorl than in the French shells, but in other respects, and particularly in the narrow, concave, posterior margins of the whorls and the peculiar character of the sinus, the two agree.

Size.—Axis, 1 inch and 9-12ths (45 millim. nearly); diameter, 9-12ths of an inch (19 millim.)

Localities.—Bracklesham Bay, where it is very rare. *French:* Grignon, Parnes, Mouchy (fide Desh.), Chaumont, Lattainville, Gomerfontaine, Mouy, Saint-Félix, Ully-Saint-Georges, La Croix blanche near Chambors (fide Graves).

Genus 27th. Borsonia. *Bellardi*, 1837.

Cordieria. *Rouault*, 1848.

Among the fossil shells found in the Miocene beds of Turin, occurs one species possessing all the general characters of Pleurotoma, that is to say, an elevated, pointed spire, a lengthened straight anterior canal, and a wide semicircular sinus, placed in the depressed posterior margin of the whorl, but distinguished from the true Pleurotoma by the presence of a single fold on the columella; and Bellardi, influenced by the importance generally attributed to the presence or absence of undoubted folds on the columella, was induced to establish the present genus for the reception of the species in question. It has been seen that among the English Pleurotomæ before described are

several, the columellæ of which present an oblique, obscure, fold-like callus, similar to that which characterises the columella of *P. cataphracta* (Brocc.) and *P. Delucii* (Nyst.); but in these instances the character is due to a callosity occasioned by the contortion of the columella. The fold presented by Bellardi's species (*Borsonia prima*) is nearly transverse, sharp, and well defined, and appears to be a true columellar fold, quite distinct in character from the callosity to which I have referred. That author, therefore, in defining his genus, has carefully excluded those species which present merely a callus-like prominence, distinct from and not to be confounded with the elevated and clearly defined fold, characteristic of Borsonia.

Subsequently other Pleurotomoid shells, from the Eocene formations in the environs of Pau, were noticed by M. Rouault, on the columella of which two or three folds were found; and that author, misapprehending apparently the true character of the fold in *Borsonia*, which he says appears to be only a small ridge on the left margin, and not a part of the columella, proposed the genus Cordieria for such Pleurotomoid shells as possessed two folds or more on the columella. The careful manner in which Bellardi has restricted the character of the fold in Borsonia, and the absolute want of any distinct generic value in the presence of one or more additional folds, appear to render the further division of the group proposed by Rouault unnecessary.

The genus Borsonia is not admitted by D'Orbigny; but, without entering into the question whether and under what conditions the presence or absence of clearly defined folds on the columella is to be regarded of generic value, it is convenient, at all events for the present, to retain Borsonia as a well-marked section of a genus already overcrowded with species.*

Two representatives of the genus are found still living, both inhabitants of tropical seas. In addition to the species noticed by Bellardi, three other Borsoniæ from Biaritz and Bos d'Arros, in the neighbourhood of Pau, have been recorded by Rouault. With one of these (*B. Biaritzana*), a species from the middle Eocene beds in England, described by Sowerby as *Pleurotoma curvicosta* in Dixon's 'Geology' &c., of Sussex, corresponds so closely that I have not ventured to retain it as distinct. Certain shells from Grignon and Parnes, described by Deshayes as *Pleurotoma nodularis*, present two folds on the columella, and will therefore belong to the present genus; and the description of a sixth species (*Borsonia sulcata*), from the upper Eocene beds, has also been given in Professor E. Forbes's memoir on the tertiary fluvio-marine of the Isle of Wight. To these two more species are now added.

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* The genus in question establishes a passage between Pleurotoma and Fasciolaria, or rather Turbinella, the folds being higher up the columella and more transverse than those of Fasciolaria, and approaching more nearly in position and character to those of Turbinella.

No. 249. Borsonia Biaritzana. *Rouault.* Tab. XXXIII, fig. 11, *a*, *b*.

Borsonia Biaritzana. *Rou.* 1848. Bull. de la Soc. Géol. de France, 2e série, vol. v, p. 207.
— Palensis. *Rou.* 1848. Idem.
Cordieria Biaritzana. *Rou.* 1848. Desc. des Foss. du térr. Eocene, des Env. de Pau (Mem. Soc. Géol. de France, 2d series, vol. iii, p. 488, tab. 17, fig. 5, *a*, 6, *a*).
Pleurotoma curvicosta. *Sow.* (non *Lamk.*) 1850. Dixon's Geol., &c., Sussex, p. 183, tab. 7, fig. 17.
— — *Morris,* 1854. Cat. Brit. Foss., p. 270.
Fasciolaria biplicata. *Sow.* 1850. Dixon's Geol., &c., Sussex, p. 184, t. 5, fig. 7.
— — *Morris,* 1854. Cat. Brit. Foss., p. 248.

B. testâ elongato-fusiformi, turritâ, longitudinaliter nodoso-costatâ, spiraliter lineatâ: spirâ acuminatâ, elevatâ, in longitudine aperturam paullo superanti: anfractibus convexis, postice canaliculatis; costis latis, rotundatis, brevibus; lineis spiralibus crebris, filiformibus: aperturâ oblongo-ovatâ, antice in canali lato brevique exeunte; labro sub-recto, in margine sinuato; sinu lato, mediocriter profundo, semicirculari; columellâ sub-cylindricâ, biplicatâ.

Shell elongated, fusiform, ribbed, and spirally lined; the spire pointed and elevated, somewhat exceeding the aperture in length. The whorls, eight or ten without the pullus, are convex, and bluntly angulated at the shoulders, and the posterior margins slope gently backwards and are concentrically furrowed. The longitudinal ribs are distant, very broad, rounded, and somewhat swelled, so as to become almost nodulous, on the shoulder; the concentric lines are numerous and thread-like, even and regular on the posterior margins and shoulders of the whorls; elsewhere they are unequal, more prominent lines alternating with the slender lines, and all are more or less strongly decussated by the lines of growth. The aperture is of an oblong ovate form, and terminates in front in a very wide and short, but distinct, canal; the outer lip is nearly straight, and presents a wide but not very deep sinus, placed in the posterior margin of the whorl; the columella is somewhat cylindrical and nearly straight, and presents, a little behind the middle, two slightly oblique, narrow folds, which do not extend to the front of the columella, and which, consequently, are scarcely visible unless the outer lip is broken off.

The specimen figured and described by Mr. Sowerby (loc. cit.) as *P. curvicosta*, forms part of my collection; at that time the aperture was closed by the matrix, and the columellar folds, therefore, were not detected. These folds have since been exposed to view, and there cannot be now any doubt of the identity of *Pleurotoma curvicosta* (Sow.) and *Fasciolaria biplicata*.

The shells from Bos d'Arros, described by Rouault, apparently do not attain so large a size as our English shells; in them the last whorl is longer, apparently, than

the spire, one of the transverse lines near the middle is more elevated than the others, and the columella sometimes presents a third fold, much smaller than the other two. In all other respects the shells from the two localities agree perfectly, and the differences do not appear to me to be sufficient to justify their being considered as specifically distinct.

The shells which Rouault, in the first instance, separated under the specific name *Palensis* were subsequently ascertained by that author to be the adult shells of *B. Biaritzana*, and were united by him to that species.

Size.—Axis, 1 inch and 5-12ths; diameter, 7-12ths of an inch, nearly.

Localities.—Bracklesham Bay and Bramshaw, at both of which places it is not uncommon. *French:* Bos d'Arros.

No. 250. Borsonia sulcata. *F. E. Edwards.* Tab. XXXIII, fig. 12, *a*, *b*.

Borsonia sulcata. *Morris*, 1856. Forbes's Tert. fluvio-mar. Form., &c., p. 154, t. 5, fig. 3, 3 *a*, 3 *b*.

B. testâ ovato-fusiformi, semi-costatâ, transversim sulcatâ; spirâ sub-turritâ, acuminatâ: anfractibus convexiusculis; marginibus postices excavatis, ad suturam marginatis, cæterum lævibus; costis crassiusculis, rotundatis; sulcis transversis sub-distantibus, irregularibus: aperturâ oblongo-ovatâ, in canali perbrevi, latissimo, exeunte; labro arcuato, postice sinuato, intûs plicato; sinu lato, paululum profundo, rotundato: columellâ oblique biplicatâ, plicis sub-æqualibus.

A small, ovately fusiform shell, longitudinally ribbed and spirally furrowed; the spire, formed of from six to eight volutions, is moderately elevated, rather exceeding the last whorl in length, and is somewhat turreted. The whorls are slightly convex; a deep, smooth furrow runs round the posterior margins, which are bordered round the suture by an elevated, ridge-like line; the last whorl is nearly conical, and terminates in front in a short, but distinct, and very wide canal. The longitudinal ribs are rather broad, very short, not extending beyond the middle of the whorls, and are lost on the last whorl of the mature shell; the spiral furrows are wide, rather deep, concave, somewhat distant, and separated by spaces wider than themselves, and rounded on the upper surface. The aperture is of an oblong-ovate form; the outer lip is moderately arched, sharp on the edge, and plicated within; and it presents, at the posterior extremity, in the marginal furrow, a wide, but not very deep, rounded sinus; and the columella is slightly arched, and bears, about the middle, two nearly equal, moderately oblique folds.

In general aspect this species presents a strong resemblance to *Borsonia* (*Pleurotoma*) *nodularis* (Desh.); but in that species the shell is wider and shorter, and the surface is nearly smooth, except over the canal, which is traversed by a few concentric,

raised lines, so faint as to be scarcely visible to the naked eye; the longitudinal ribs also are thicker and more distant, and they extend to the very front of the whorl.

Size.—Axis, rather more than 6-12ths of an inch; diameter, rather more than 2-12ths of an inch.

Localities.—Headon Hill, and Colwell Bay, Isle of Wight; and Hordwell.

No. 251. Borsonia semicostata. *F. E. Edwards.* Tab. XXXIII, fig. 13, *a*, *b*.

B. testâ ovato-fusiformi, semi-costatâ, omnino spiraliter lineatâ: spirâ elatâ, turritâ: anfractibus convexiusculis, postice canaliculatis; costis numerosis, rotundatis; lineis spiralibus elevatis, acutis, supra margines anfractûum exilibus, regularibus; cæterûm irregularibus, sub-distantibus, duabus sub-medianis elatioribus: aperturâ oblongo-ovali, in canalem latum perbrevem productâ; labro leviter arcuato, postice sinuato, intus lævi; columellâ oblique inequaliter biplicatâ, plicâ anticâ minori.

Shell small, ovately fusiform, longitudinally ribbed, and covered with raised, concentric lines; the spire turreted and elevated, exceeding the aperture in length. The whorls, which are six in number without the pullus, are convex, and channelled round the posterior margins; the last whorl is rather suddenly contracted towards the front, tapering thence gradually towards the base, where it terminates in a very short, wide canal. The ribs are rather numerous, not very broad, rounded on the upper surface, of equal thickness, and short, ending abruptly where the whorl contracts; the transverse lines over the posterior margins are very fine, even, and regular; a sharp, elevated line crosses the shoulders, in front of which appear four other elevated lines, which gradually become more and more prominent and distant as they recede from the shoulders; the front two are more prominent and wider apart than the rest; they are separated by a broad, concave furrow, and swelled into small, tooth-like knobs, where they cross the longitudinal ribs; the lines over the front part of the whorl and the canal are irregular and very obscure, almost obsolete. The aperture is of an oblong-oval shape; the outer lip is very slightly arched, and presents a shallow and not very wide, rounded sinus, placed in the marginal depression; the columella is nearly straight, and furnished with two unequal, oblique folds, placed near the middle, the front one of which is the smaller.

In general aspect, this shell so closely resembles *Borsonia sulcata*, that a doubt may fairly be raised whether it ought not to be regarded as a variety of that species. It will be seen, however, on comparison, that in *B. sulcata* the spire is longer, that the posterior margins are not so wide nor so deeply channelled, and that they are spirally lined, and not smooth; that the costæ are narrower and more numerous, and the transverse ornamentation quite distinct in character; that the outer lip is not so

much arched, and is smooth within; and that the columellar folds are more oblique, more unequal, and not so prominent.

Size.—Axis, 4-12ths of an inch; diameter, rather less than 2-12ths of an inch.

Locality.—Barton, where, apparently, it is rare.

No. 252. Borsonia lineata. *F. E. Edwards.* Tab. XXXIII, fig. 14, *a*, *b*.

B. testâ parvâ, ovato-fusiformi, sub-turritâ, lineis spiralibus costellisque longitudinalibus sese decussantibus, omnino clathratâ: anfractibus convexis, postice sulco concentrico profunde exaratis, ad suturam lineato-marginatis; lineis spiralibus elevatis, irregularibus; costellis numerosis, angustis, pliciformibus, arcuatis: aperturâ oblongo-ovali, antice in canali brevi, latiusculo, exeunte; labro sub-recto, postice profunde sinuato, intûs plicifero; columellâ parum tortuosâ, biplicatâ.

Shell small, ovately fusiform, sub-turreted, and ornamented with concentric lines and longitudinal ribs, imparting to the surface, by their decussation, the appearance of a fine lattice-work; the spire is of equal length with the aperture, and is rather thick and pointed. The whorls, five or six without the pullus, are convex; the posterior margins slope very gently backwards, and are traversed by a deep, but not very wide, furrow, feebly crenulated; the sutural edge is bordered either by a single, rather thick, elevated line, sometimes granulated, or by a narrow band, formed of two elevated lines, separated by a shallow, but perspicuous furrow; the longitudinal ribs, which are subordinate in character to the concentric lines, are not very prominent, but numerous, narrow, fold-like, oblique, slightly arched, and sharply defined at their posterior extremities by a concentric line, which borders the marginal furrow and gives an angulated appearance to the shoulders; in front of this are two equal, closely set, not very prominent lines, and to these succeed other sharp, equal, transverse lines, which become gradually more distant until they reach the anterior canal, over which the transverse lines again approach more closely. The aperture is of a rather narrow, oblong-oval form, and is produced in front into a short, moderately wide, canal; the outer lip is nearly straight, and presents, at the posterior margin, a deep, semi-elliptical sinus; the columella is slightly twisted, and bears at the middle two oblique and nearly equal folds.

This well-marked species is found at Highcliff; it is somewhat rare.

Size.—Axis, 7-24ths of an inch; diameter, 2-12ths of an inch.

CONIDÆ.

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vicina, *Edw.*, t. 29, fig. 10, *a*, *b* . 266

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B. Sinus on the shoulder of the whorl.

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cataphracta, Morr. Cat. 1st Edit. (*non Brocc.*) . . . 311
cedilla, *Edw.*, t. 31, fig. 5, *a*, *b* . 300
colon, Sow. . . . 311
comma, *Sow.*, t. 30, fig. 2 . . 281
conifera, *Edw.*, t. 31, fig. 3, *a*, *b* . 274
crebrilinea, *Edw.*, t. 30, fig. 6, *a—c* . 290
curta, *Edw.*, t. 31, fig. 2, *a*, *b* . 305
denticula, *Bast.*, t. 30, fig. 7, *a—h* . 286
divisa, *Edw.*, t. 31, fig. 17, *a*, *b* . 278
fasciolata, *Edw.*, t. 30, fig. 12, *a*, *b* . 286
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parilis, *Edw.*, t. 31, fig. 10, *a—c* . 309
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Sect. II.—*Shells coniform.*

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Borsonia Biaritzana, *Rou.*, t. 33, fig. 11, *a*, *b* . 327
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ADDENDA AND CORRIGENDA.

Page 255, line 13, *dele* Barton.
„ 274, last line, *add* Brook.
„ 275, first line, *for* fig. 13, *a*, *b*, *read* fig. 15, *a*, *b*.
„ 279, line 25, *for* Hampstead Railway Tunnel, *substitute* Potter's Bar.
„ 282, last line, *add* Highgate, Potter's Bar, and Southampton.
„ 285, line 17, *add* Hornsey.
„ 290, line 16, *for* fig. 8, *a—c*, *read* fig. 6, *a—c*.
„ 295, line 8, *add* Highgate.
„ 300, last line, *add* Highcliff.

TAB. XXVIII.

NOTE.—*The lines indicate the actual dimensions of the specimens.*

Fig.

1. Pleurotoma innexa. No. 162, *p.* 241.
   - *a.* Side view of young shell, nat. size; from Barton.
   - *b.* Ditto of adult shell, nat. size.
   - *c.* Ditto of body-whorl, magnified.

2. Pleurotoma turpis. No. 189, *p.* 267.
   - *a.* Side view, nat. size; from Clarendon.
   - *b.* Ditto of body-whorl, magnified.
   - *c.* Back view, nat. size.

3. Pleurotoma inflexa. No. 163, *p.* 242.
   - *a.* Front view, nat. size; from Bracklesham Bay.
   - *b.* Back view, ditto; from Bramshaw.
   - *c.* Side view of body-whorl, magnified.

4. Pleurotoma granulata. No. 186, *p.* 264.
   - *a.* Back view, magnified; from Highcliff.
   - *b.* Front view, ditto.
   - *c.* Side view of body-whorl, magnified.

5. Pleurotoma lissa. No. 191, *p.* 268.
   - *a.* Back view, magnified; from Potter's Bar.
   - *b.* Front view, ditto.

6. Pleurotoma tricincta. No. 174, *p.* 252.
   - *a.* Back view, magnified; from Potter's Bar.
   - *b.* Ditto of body-whorl and part of the spire, magnified.

7. Pleurotoma dissimilis. No. 167, *p.* 246.
   - *a.* Side view, magnified; from Highcliff.
   - *b.* Front view, ditto.
   - *c.* Ditto of body-whorl, magnified.

8. Pleurotoma microcheila. No. 166, *p.* 245.
   - *a.* Back view, magnified; from Highcliff.
   - *b.* Front view, magnified.
   - *c.* Side view of body-whorl, and part of the spire, magnified.
   - *d.* Front view, magnified (var. *producta*); from Highcliff.
   - *e.* Back view, magnified (ditto).
   - *f.* Front view of body whorl, magnified (ditto).

Fig.

9. Pleurotoma pupa. No. 175, *p.* 253.
   - *a.* Side view, magnified; from Highcliff.
   - *b.* Ditto of body-whorl, magnified.
   - *c.* Front view, magnified.

10. Pleurotoma lepta. No. 164, *p.* 244.
   - *a.* Side view, magnified; from Stubbington.
   - *b.* Ditto of body-whorl, magnified.
   - *c.* Back view, magnified.

11. Pleurotoma plicata. No. 169, p. 248.
   - *a.* Front view, nat. size; from Bramshaw.
   - *b.* Ditto of body-whorl, and part of the spire, magnified.
   - *c.* Back view, nat. size.

12. Pleurotoma coarctata. No. 165, *p.* 245.
   - *a.* Back view, magnified; from Highcliff.
   - *b.* Front view, ditto.
   - *c.* Side view of body-whorl, magnified.

13. Pleurotoma gomphoidea. No. 168, p. 247.
   - *a.* Back view, nat. size; from Highcliff.
   - *b.* Front view, ditto.
   - *c.* Ditto of body-whorl, and part of the spire, magnified.
   - *d.* Back view, nat. size; from Clarendon.
   - *e.* Ditto of body-whorl, magnified.
   - *f* 1. Front view (var. *avita*), nat. size; from Southampton.
   - *f* 2. Ditto (ditto) magnified.

Pleurotoma acuticosta. No. 170, *p.* 249.
   - *a.* Back view, nat. size; from Barton.
   - *b.* Front view, ditto.
   - *c.* Ditto of body-whorl, and part of the spire, magnified.

15. Pleurotoma dilinum. No. 173, *p.* 252.
   - *a* 1. Front view, magnified; from Alum Bay (Strat. No. 29, Prestw.)
   - *a* 2. Side view, magnified.
   - *b.* Ditto of body-whorl, magnified.

16. Pleurotoma pyrgota. No. 179, *p.* 257.
   - *a.* Back view, nat. size; from Bramshaw.
   - *b.* Front view, ditto.
   - *c.* Ditto of body-whorl, and part of the spire, magnified.

17. Pleurotoma Headonensis. No. 187, *p.* 265.
   - *a.* Back view, magnified; from Headon Hill.
   - *b.* Ditto of body-whorl, and part of the spire, magnified.
   - *c.* Front view, magnified.

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TAB. XXIX.

NOTE.—*The lines indicate the actual dimensions of the specimens.*

Fig.

1. Pleurotoma constricta. No. 178, *p.* 256.
   - *a.* Side view, natural size; from Barton.
   - *b.* Ditto of body-whorl, magnified.
   - *c.* Front view, nat. size.

2. Pleurotoma scabriuscula. No. 176, *p.* 254.
   - *a.* Back view, magnified; from Highcliff.
   - *b.* Side view, ditto.
   - *c.* Ditto, ditto.

3. Pleurotoma verticillum. No. 177, *p.* 255.
   - *a.* Back view, nat. size; from Barton.
   - *b.* Ditto of body-whorl, and part of the spire, magnified.
   - *c.* Front view, nat. size.

4. Pleurotoma turgidula. No. 172, *p.* 251.
   - *a.* Back view, nat. size; from Alum Bay (Strat. No. 29, Prestw.?)
   - *b.* Side view, ditto.
   - *c.* Ditto of the body-whorl, magnified.

5. Pleurotoma tereticosta. No. 171, *p.* 250.
   - *a.* Back view, nat. size; from Highgate.
   - *b.* Ditto, magnified.
   - *c.* Ditto, (var. *soror*), nat. size; from Southampton.
   - *d.* Ditto, (ditto) magnified.

6. Pleurotoma brevirostrum. No. 180, *p.* 258.
   - *a.* Back view, nat. size; from Muddiford? (*Mus. Sow.*)
   - *b.* Front view, ditto.

7. Pleurotoma nodulosa. No. 181, *p.* 260.
   - *a.* Back view, nat. size; from Stubbington.
   - *b.* Front view, ditto.
   - *c.* Side view, magnified.

8. Pleurotoma nodosaria. No. 182, *p.* 261.
   - *a.* Back view, magnified; from Southampton.
   - *b.* Front view, ditto.

Fig.

9. Pleurotoma bracheia. No. 184, *p.* 263.
   - *a.* Side view, magnified; from Barton.
   - *b.* Ditto, ditto.

10. Pleurotoma vicina. No. 188, *p.* 266.
   - *a.* Side view, magnified; from Alum Bay (Strat. No. 29, Prestw.)
   - *b.* Front view, ditto.

11. Pleurotoma undata. No. 183, *p.* 261.
   - *a.* Back view, nat. size; from Stubbington.
   - *b.* Front view, ditto.

12. Pleurotoma sindonata. No. 185, *p.* 263.
   - *a.* Side view, magnified; from Stubbington.
   - *b.* Front view, ditto.

13. Pleurotoma subula. No. 190, *p.* 267.
   - *a.* Back view, nat. size; from Basingstoke.
   - *b.* Ditto, magnified.

14. Pleurotoma aspera. No. 197, *p.* 273.
   - *a.* Back view, nat. size; from Barton.
   - *b.* Side view, ditto; from Highcliff.

15. Pleurotoma Koninckii. No. 204, *p.* 279.
   - *a.* Front view, nat. size; from Railway Tunnel, Hampstead.
   - *b.* Back view, ditto.

16. Pleurotoma Wetherellii. No. 211, *p.* 285.
   - *a* and *d.* Back views of young shells, nat. size; from Highgate.
   - *b.* Back view of adult shell, ditto; (*Mus. Weth.*)
   - *c.* Front view of ditto.

17. Pleurotoma Selysii. No. 203, *p.* 278.
   - *a.* Front view of shell of mid-growth, nat. size; from Muswell Hill (*Mus. Weth.*)
   - *b.* Side view ditto, ditto.
   - *c.* Back view of adult shell, nat. size (*Mus. Weth.*)
   - *d.* Ditto of shell of mid-growth, ditto (*ditto*).

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TAB. XXX.

NOTE.—*The lines indicate the actual dimensions of the specimens.*

Fig.

1. Pleurotoma gentilis. No. 205, *p.* 280.
   - *a.* Front view, natural size; from Bracklesham Bay.
   - *b.* Back view, ditto.
   - *c.* Part of the body-whorl, magnified.

2. Pleurotoma comma. No. 206, *p.* 281.
   Front view, nat. size; from Stubbington.

3. Pleurotoma Prestwichii. No. 207, *p.* 282.
   - *a.* Back view, nat. size; from Clarendon.
   - *b.* Part of the body-whorl, magnified.
   - *c.* Back view (var.), nat. size.
   - *d.* Side view (var.), ditto.

4. Pleurotoma simillima. No. 208, *p.* 283.
   - *a.* Back view, nat. size; from Clarendon.
   - *b.* Side view, ditto.
   - *c.* Part of the body-whorl, magnified.

5. Pleurotoma mixta. No. 201, *p.* 277.
   - *a.* Back view, nat. size; from Barton.
   - *b.* Front view, ditto.

6. Pleurotoma crebrilinea. No. 214, *p.* 290.
   - *a.* Back view, nat. size; from Stubbington.
   - *b.* Front view, ditto.
   - *c.* Part of the body-whorl, magnified.

7. Pleurotoma denticula. No. 213, *p.* 286.
   - *a.* Back view, nat. size; from Bracklesham Bay.
   - *b.* Part of the body-whorl, magnified.
   - *c.* Back view, nat. size; from Barton.
   - *d.* Ditto (var. *longæva*), nat. size; from Highgate.
   - *e.* Ditto (var. *macrobia*), ditto; from Clarendon.
   - *f.* Ditto (var. *gracilenta*), ditto; from Brook, in the New Forest.
   - *g.* Side view (var. *conulus*), ditto; from Barton.
   - *h.* Back view (var. *odontella*), ditto; from Colwell Bay.

Fig.

8. Pleurotoma Waterkeynii. No. 200, *p.* 275.
   - *a.* Front view, nat. size; from Potter's Bar.
   - *b.* Back view, ditto.
   - *c.* Part of the body-whorl, magnified.

9. Pleurotoma callifera. No. 215, *p.* 291.
   - *a.* Front view, magnified; from Highcliff.
   - *b.* Side view, ditto.

10. Pleurotoma callifera, var. *monilifera.* No. 215, *p.* 291.
   - *a.* Back view, nat. size; from Barton.
   - *b.* Front view, ditto.

11. Pleurotoma callifera, var. *raphium.* No. 215, *p.* 291.
   - *a.* Back view, magnified; from Highcliff.
   - *b.* Side view, ditto.

12. Pleurotoma fasciolata. No. 212, *p.* 286.
   - *a.* Back view, shell of mid-growth, nat. size; from Highgate.
   - *b.* Front view, adult shell, ditto; from Railway Cutting, at Kilburn.

13. Pleurotoma tæniolata. No. 210, *p.* 284.
   - *a.* Back view, nat. size; from Cuffell (*Mus. Prestw.*)
   - *b.* Front view, ditto.
   - *c.* Part of the body-whorl, ditto.

14. Pleurotoma abnormis. No. 218, p. 294.
   - *a.* Back view, nat. size; from Highgate.
   - *b.* Front view, ditto.

15. Pleurotoma Volgeri. No. 199, *p.* 275.
   - *a.* Back view, nat. size; from Potter's Bar.
   - *b.* Ditto, magnified.

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TAB. XXXI.

NOTE.—*The lines indicate the actual dimensions of the specimens.*

Fig.

1. Pleurotoma obscurata. No. 220, *p.* 296.
   - *a.* Front view of shell of mid-growth, nat. size; from Bracklesham Bay.
   - *b.* Back view of adult shell, ditto.

2. Pleurotoma curta. No. 230, *p.* 305.
   - *a.* Back view, magnified; from Alum Bay (Strat. No. 29, Prestw.)
   - *b.* Front view, ditto.

3. Pleurotoma conifera. No. 198, *p.* 274.
   - *a.* Back view, nat. size; from Bracklesham Bay.
   - *b.* Front view, ditto; from Bramshaw.

4. Pleurotoma rotella. No. 223, *p.* 299.
   - *a.* Back view, magnified; from Highcliff.
   - *b.* Side view, ditto.

5. Pleurotoma cedilla. No. 224, *p.* 300.
   - *a* and *b.* Back views, magnified; from Barton.

6. Pleurotoma scalarata. No. 219, *p.* 295.
   - *a.* Back view, nat. size; from Bramshaw.
   - *b.* Side view, ditto.

7. Pleurotoma granata. No. 234, *p.* 308.
   - *a.* Front view, nat. size; from Highgate.
   - *b.* Back view, ditto.
   - *c.* Part of the body-whorl, magnified.

8. Pleurotoma Hantoniensis. No. 240, *p.* 315.
   - *a.* Back view, shell of mid-growth, nat. size; from Lyndhurst.
   - *b.* Side view, ditto, ditto; from Brockenhurst.
   - *c.* Front view, adult shell, ditto.

Fig.

9. Pleurotoma rotundata. No. 233, *p.* 307.
   a. Front view, nat. size; from Highgate.
   b. Front view, ditto; from Potter's Bar.

10. Pleurotoma parilis. No. 235, *p.* 309.
   a. Side view, nat. size; from Highgate.
   b. Part of the body-whorl, magnified.
   c. Front view, nat. size.

11. Pleurotoma variata. No. 228, *p.* 303.
   Front view, magnified; from Clarendon.

12. Pleurotoma varians. No. 217, *p.* 293.
   a. Side view of young shell, magnified; from Highcliff.
   b. Back view, adult shell, nat. size.

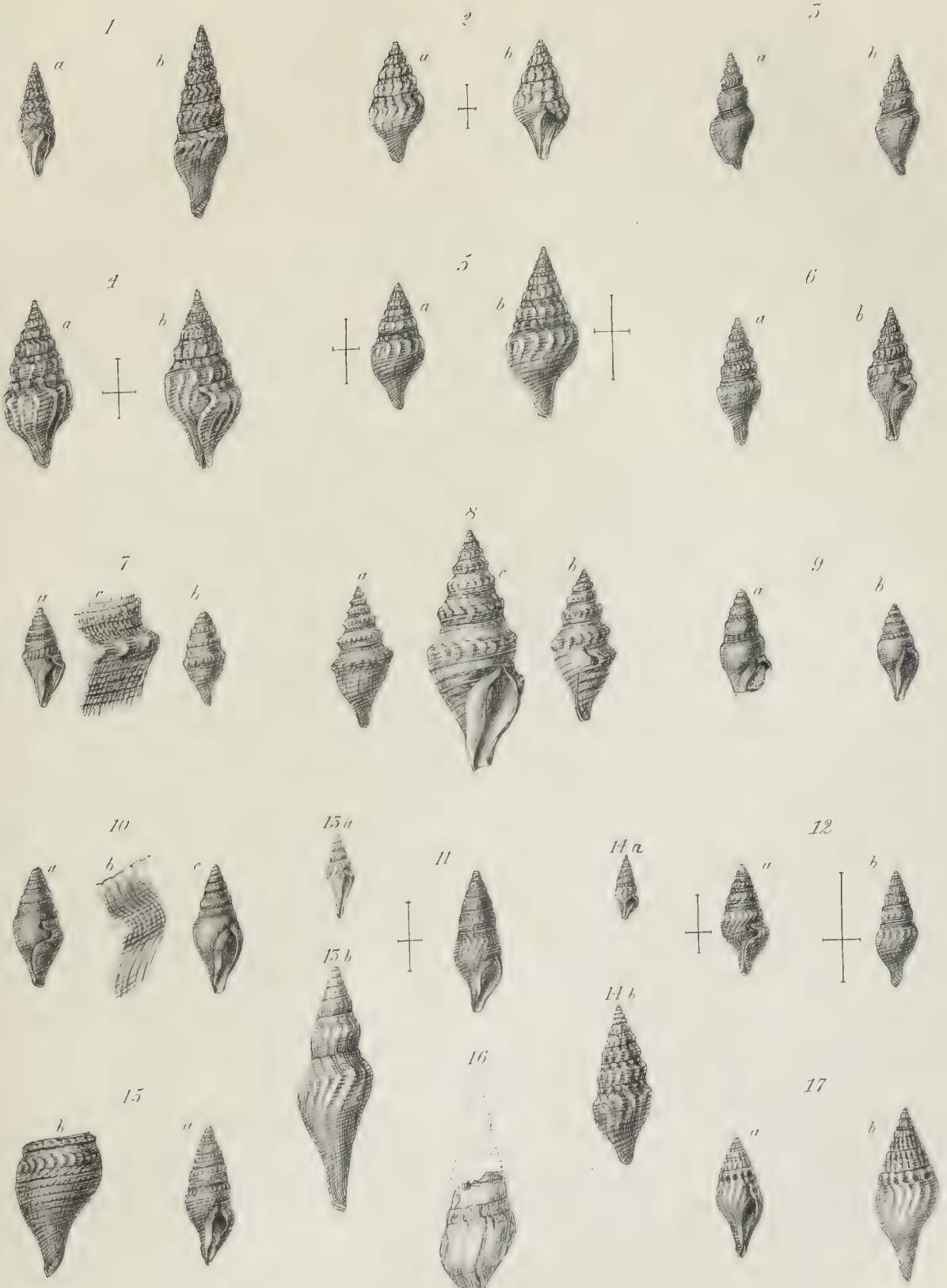
13. Pleurotoma Lehonii. No. 194, *p.* 271.
   a. Back view, nat. size; from Highgate (*Mus. Weth.*)
   b. Back view, magnified.

14. Pleurotoma Fisheri. No. 192, *p.* 269.
   a. Front view, nat. size; from Brook (New Forest).
   b. Back view, magnified.

15. Pleurotoma puella. No. 231, *p.* 305.
   a. Front view, nat. size; from Barton.
   b. Back view of the body-whorl, magnified.

16. Pleurotoma zeta. No. 209, *p.* 284.
   Back view, nat. size; from Bracklesham Bay.

17. Pleurotoma divisa. No. 202, *p.* 278.
   a. Front view, shell of mid-growth, nat. size; from Bracklesham Bay.
   b. Back view, adult shell, ditto.



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TAB. XXXII.

NOTE—*The lines indicate the actual dimesions of the specimens.*

Fig.

1. Pleurotoma monerma. No. 216, *p.* 292.
   - *a.* Back view, young shell, nat. size; from Highcliff.
   - *b.* Side view, adult shell, ditto.
   - *c.* Part of the body-whorl, magnified.

2. Pleurotoma turbida. No. 237, *p.* 311.
   - *a.* Side view, adult shell, nat. size; from Barton.
   - *b.* Back view, shell of mid-growth, nat. size.
   - *c.* Side view, ditto ditto; from Highcliff.

3. Pleurotoma lima. No. 221, *p.* 296.
   - *a.* Side view, shell of mid-growth, nat. size; from Barton.
   - *b* and *c.* Back views, adult shells; ditto.

4. Pleurotoma reticulosa. No. 222, *p.* 298.
   - *a.* Side view of young shell, nat. size; from Barton.
   - *b.* Back view, adult shells, ditto.

5. Pleurotoma acutisinuata. No. 232, *p.* 306.
   - *a.* Side view, nat. size; from Bracklesham Bay.
   - *b.* Outer lip, showing the sinus, magnified.

6. Pleurotoma zonulata. No. 241, *p.* 317.
   - *a.* Back view, magnified; from Barton.
   - *b.* Side view, ditto.

7. Pleurotoma helicoides. No. 244, *p.* 319.
   - *a.* Side view of young shell, magnified; from Barton.
   - *b.* Ditto of adult shell, ditto.

8. Pleurotoma flexuosa. No. 226, *p.* 302.
   - *a.* Front view, nat. size; from Shinfield (*Mus. Prestw.*)
   - *b.* Back view, ditto, from Clarendon.
   - *c.* Front view of the body-whorl of fig. *a*, magnified.

Fig.

9. Pleurotoma læviuscula. No. 236, *p.* 310.
   - *a.* Back view, nat. size; from Brockenhurst.
   - *b.* Ditto of the body-whorl, magnified.

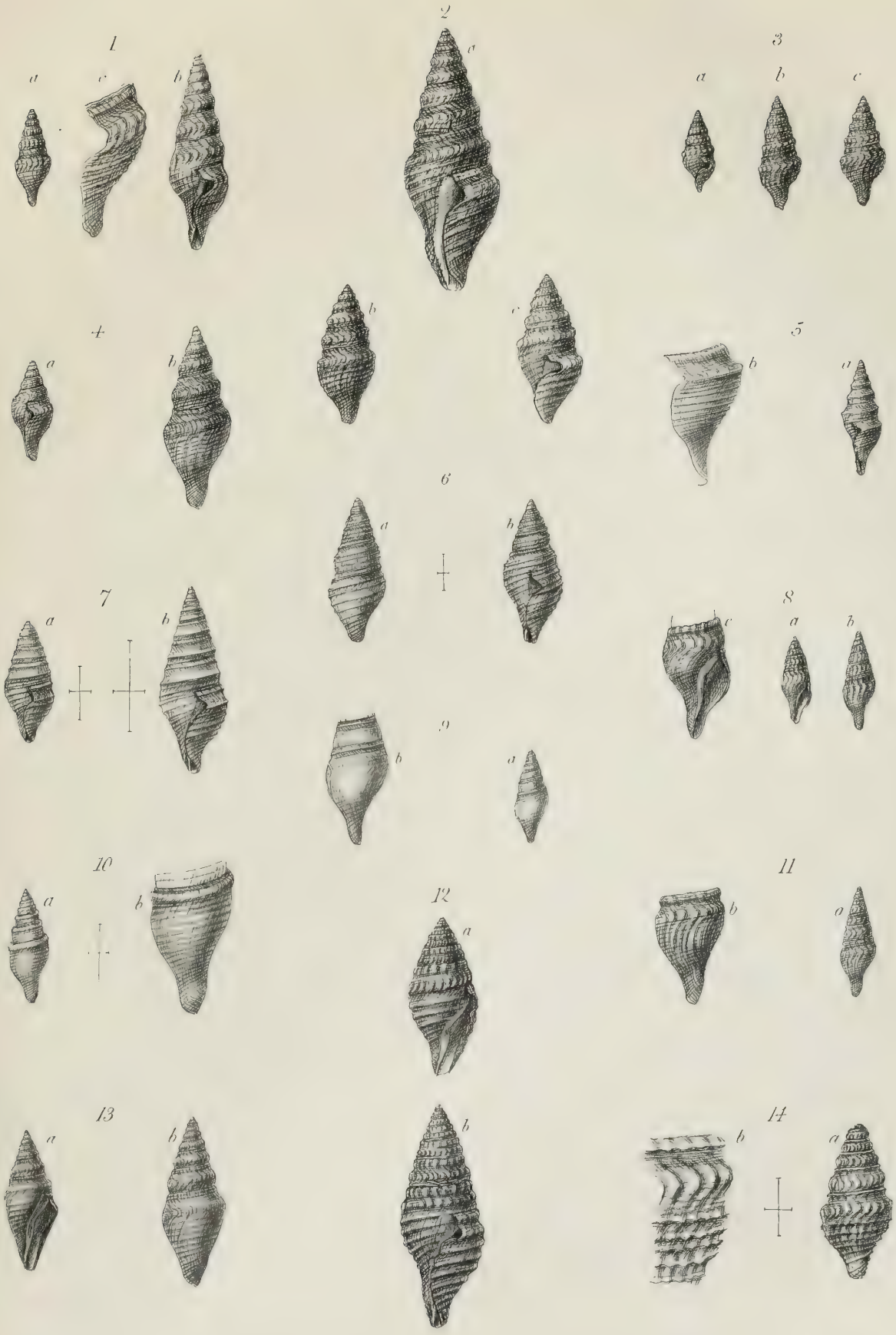
10. Pleurotoma Woodii. No. 229, *p.* 304.
   - *a.* Back view, magnified; from Headon Hill.
   - *b.* Ditto, of the body-whorl, magnified.

11. Pleurotoma pupoides. No. 227, *p.* 302
   - *a.* Back view, nat. size; from Clarendon.
   - *b.* Ditto of the body-whorl, magnified.

12. Pleurotoma ligata. No. 238, *p.* 313.
   - *a.* Front view of shell of mid-growth, nat. size; from Bramshaw.
   - *b.* Side view of adult shell, ditto.

13. Pleurotoma hemileia. No. 239, *p.* 314.
   - *a.* Front view, nat. size; from Alum Bay (Strat. No, 29, Prestw.)
   - *b.* Back view, ditto.

14. Pleurotoma insignis. No. 225, *p.* 301.
   - *a.* Back view, magnified; from Alum Bay (Strat. No. 4, Prestw.)
   - *b.* Part of the body-whorl, much magnified.



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TAB. XXXIII.

NOTE.—*The lines indicate the actual dimensions of the specimens.*

Fig.

1. Pleurotoma prisca. No. 245, *p.* 320.
   - *a.* Side view of adult shell, nat. size; from Barton.
   - *b.* Side view of young shell, ditto.
   - *c.* Front view of adult shell, nat. size; from Bramshaw.
   - *d.* Front view ditto, ditto; from Barton.
   - *e.* Side view of shell of mid-growth, ditto; from Bracklesham Bay.

2. Pleurotoma amphiconus. No. 246, *p.* 322.
   - *a.* Side view of shell of mid-growth, nat. size; from Bracklesham Bay.
   - *b.* Back view of adult shell, ditto.

3. Pleurotoma semistriata. No. 247, *p.* 323.
   - *a.* Back view, nat. size; from Bramshaw.
   - *b.* Front view, ditto.

4. Pleurotoma glabrata. No. 248, *p.* 324.
   Front view, nat. size; from Bracklesham Bay.

5. Pleurotoma conoides. No. 242, *p.* 317.
   - *a.* Back view of adult shell, nat. size; from Barton.
   - *b.* Side view of shell of mid-growth; ditto.

6. Pleurotoma cochlis. No. 196, *p.* 272.
   Back view of adult shell, nat. size; from Shinfield (*Mus. Prestw.*)

7. Pleurotoma biconus. No. 243, p. 318.
   - *a.* Back view of adult shell, magnified; from Highcliff.
   - *b.* Side view, ditto.

8. Pleurotoma macrura. No. 195, *p.* 271.
   - *a.* Back view of shell in the matrix, nat. size; from Finchley.
   - *b.* Part of the body-whorl, magnified.

Fig.

9. Pleurotoma Tallavignesii. No. 193, *p.* 270.
   - *a.* Side view of young shell, magnified; from Nuneham.
   - *b.* Back view of adult shell, nat. size; from Southend (*Mus. Prestw.*)

10. Metula juncea.
   - *a.* Back view, nat. size; from Barton.
   - *b.* Side view, ditto.
   - *c.* Front view, ditto.

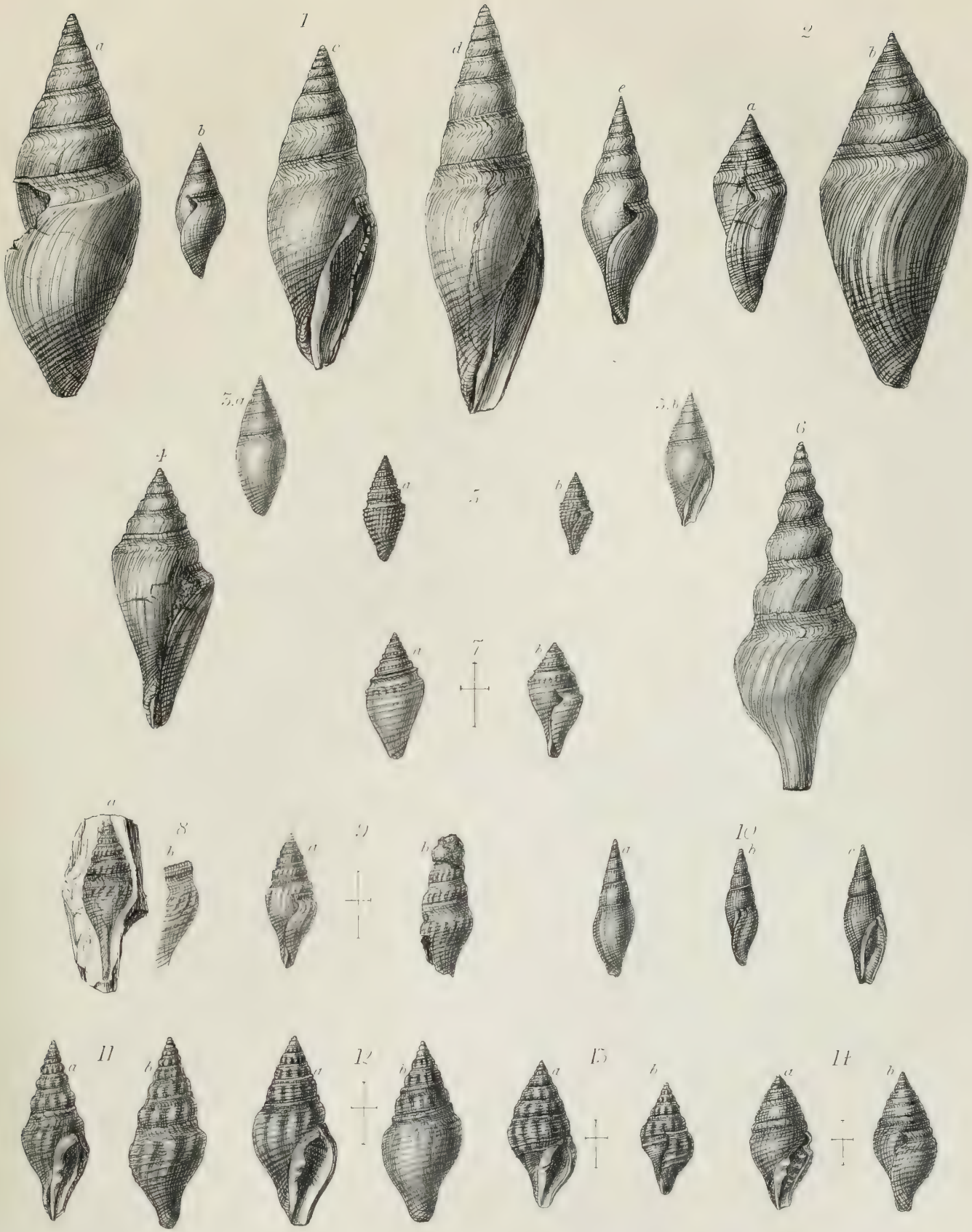
11. Borsonia Biaritzana. No. 249, *p.* 327.
   - *a.* Front view, nat. size; from Bramshaw.
   - *b.* Back view, ditto; from Bracklesham Bay.

   The specimen represented by fig. 11, *b*, is that figured and described in Dixon's 'Geology, &c., of Sussex,' as *Fasciolaria biplicata*.

12. Borsonia sulcata. No. 250, *p.* 328.
   - *a.* Front view, magnified; from Colwell Bay.
   - *b.* Back view, ditto.

13. Borsonia semicostata. No. 251, *p.* 329.
   - *a.* Front view, magnified; from Barton.
   - *b.* Side view, ditto.

14. Borsonia lineata. No. 252, *p.* 330.
   - *a.* Front view, magnified; from Highcliff.
   - *b.* Side view, ditto.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THE

PALÆONTOGRAPHICAL SOCIETY.

INSTITUTED MDCCCXLVII.

ISSUED FOR 1858.

LONDON:

MDCCCLX.

MONOGRAPH

OF

THE FOSSIL REPTILIA

OF THE

CRETACEOUS AND PURBECK STRATA;

INCLUDING

SUPPLEMENT No. III.

CRETACEOUS PTEROSAURIA AND SAUROPTERYGIA.

SUPPLEMENT No. II.

IGUANODON,

AND

PURBECK LACERTILIA.

BY

PROFESSOR OWEN, F.R.S., F.L.S., F.G.S., &c.

LONDON:

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SUPPLEMENT (No. III)

TO THE

MONOGRAPH

ON

THE FOSSIL REPTILIA

OF

THE CRETACEOUS FORMATIONS.

Order—*PTEROSAURIA*, *Owen.*

Genus—Pterodactylus, *Cuvier.*

In former monographs on the fossil reptilia of the Upper Green-sand of Cambridgeshire,* I have described, figured, or referred to, parts of a Pterodactyle, from an individual surpassing in size that to which the portions of upper and lower jaw† belonged on which the species dedicated to Professor Sedgwick was founded. Such fossil evidences of more gigantic flying reptiles, showing no better distinctive characters, were deemed, probably, to belong to the *Pterodactylus Sedgwickii*,‡ the then largest known species of the genus.

I am now, however, enabled to adduce, from the more recently acquired additions to the Woodwardian Museum at Cambridge, supplied to me by the same unfailing liberality of the eloquent Professor, evidences of a much larger Pterodactyle, distinct, in regard to the form of the skull, from any previously known, and one which, assuming that the portion of upper jaw of *Pterodactylus Sedgwickii* (Tab. I, fig. 1, 'Monograph' of 1857) belonged to a full-grown specimen, must have acquired at least double the dimensions of that species.

* 'Monograph on Fossil Reptilia of the Cretaceous Formations' (1857), tab. i, p. 6; tab. iv, figs. 1, 2, and 3.

† Ibid., t. i, figs. 1 and 2.

‡ Ibid., p. 5.

PTERODACTYLUS SIMUS, *Owen.*

Jaws and teeth (Tab. I, figs. 1—10).

The first evidence I have to offer of this truly gigantic flying reptile consists of the corresponding part of the upper jaw with that on which the *Pterodactylus Sedgwickii* was founded, viz., the anterior extremity forming the muzzle (Tab. I, figs. 1—5), including the first four (*a, b, c, d*) and part of the fifth (*e*) sockets of the teeth. The comparison and appreciation of the specific distinctions of the two large Pterodactyles are thus rendered easy and satisfactory.

In the specimen of *Pterodactylus simus* (Tab. I, figs. 1—5), the first tooth (*a*) on the left side remains in the socket; it is not larger than the corresponding tooth in *Pterodactylus Sedgwickii*, and, consequently, is relatively much smaller than in that species. Its socket and that of its fellow, moreover, are differently situated, opening downwards, like the succeeding sockets, and the position of the exserted foremost tooth is accordingly vertical and nearly parallel with the lower half of the anterior contour of the muzzle. In *Pterodactylus Sedgwickii*, the sockets of the first pair of teeth open upon the forepart of the muzzle, and look almost directly forward,* and their teeth had, consequently, a nearly similar direction; the same, viz., which they appear to have had in *Pterodactylus suevicus*, Qnst.†

The contour of the muzzle in *Pterodactylus Sedgwickii* rises at first vertically above these sockets before curving back into the upper part of the skull's profile, and gives an obtuse anterior termination to the upper jaw;‡ but this character is much exaggerated in the present specimen (Tab. I, figs. 1 and 3), not only by the greater relative extent of the vertical part above the front sockets, but by the greater breadth of that part, which is flattened anteriorly, forming a surface (fig. 3) of nearly 2 inches in length, about 10 lines in breadth below, and contracting gradually above to a point, where the blunt ridge begins that forms the upper part of the profile of this portion of the skull. The name proposed for the species refers to this peculiarly obtuse and flattened forepart of the cranium. In *Pterodactylus Sedgwickii*, the upper ridge of the forepart of the cranium is continued down to between the first pair of sockets,§ the muzzle being only obtuse vertically, and not transversely, as in *Pterodactylus simus*.

The flattened anterior surface, in the specimen figured (Tab. I, fig. 3), is im-

* 'Monograph' for 1857, tab. i, fig 1, *c*.

† 'Ueber *Pterodactylus suevicus*,' &c., 4to, 1855, tab. i.

‡ 'Monograph' for 1857, p. 2, tab. i, fig. 1.

§ Ib., tab. i, fig. 2.

pressed by a very shallow and wide, longitudinal or vertical channel; but this is scarcely marked in a second specimen of a muzzle of the same species. In both specimens the outer surface of the flattened part is less smooth than at the sides of the muzzle, being impressed by numerous irregular, linear grooves, seemingly vascular, affecting the vertical direction at the upper part, and the transverse direction at the rest of the surface.

The ridge where the two sides of the muzzle meet, above and beyond the flattened surface, is more obtuse and is relatively thicker than in *Pterodactylus Sedgwickii*. Were the same curve to be continued from the part of the ridge preserved until it became horizontal, the vertical diameter of the skull at this part would be not less than three inches; it may, however, have risen to a greater height, for the contour is not regularly curved, but sub-angular, as shown in figs. 1 and 2.

The facial part of the skull must have been narrow in proportion to its height, and, no doubt, also to its length. The broadest part of the present fragment does not exceed one inch and a quarter at the fourth pair of sockets; the adherent matrix (*m, m,* figs. 4 and 5) gives a seeming greater breadth to this part of the skull.

The sockets of the first pair of teeth (*a*) are three lines apart, the interspace equalling the largest diameter of the socket; the bone forming this anterior termination of the palate projects as a convexity below the level of the alveolar openings, the plane of which is a little inclined outwards. This inclination is increased in those of the second pair of sockets, which are nearly double the size of the first, and are five lines apart. The second is separated from the first socket by an interval of two lines; its outlet has a full, oval form. The third socket is four lines distant from the second, and exhibits the same ratio of increase of size; there is a shallow, vertical depression on the outer alveolar wall, between the second and third tooth, the socket of the latter appearing to have made a slight prominence on that part of the jaw. The palate at the interspace between the second and third pairs of sockets is flat, showing no trace of the median ridge characterising that part of the upper jaw, or of the groove at the corresponding part of the lower jaw, in the *Pterodactylus Sedgwickii*.

The upper jaw of the *Pterodactylus simus*, in the present specimen, has been partially fractured across the third pair of sockets (figs. 1, 2, 5, *c*), of which only the forepart of the left one is here preserved, showing well-marked vascular grooves. Its outlet, from this fracture, appears to be of a larger oval or ellipse than in the second socket.

The fourth socket (*d*) is preserved only on the right side, with about the right half of the corresponding part of the bony palate. The outlet of this socket resembles in shape and size that of the second; it is three lines distant from the third socket.

The fifth socket (*e*), the forepart of which is preserved on the right side, is four lines distant from the fourth.

The thinness of the compact outer wall of this fragment of the upper jaw, and the large size of the cancelli, concur with the dental characters in demonstrating the Pterosaurian nature of the fossil. So far as the outer wall is preserved, it shows no trace of the external nostril at a distance, viz., of three inches from the forepart of the upper jaw.

The tooth in place is sub-compressed, conical, long, and slightly curved, with the convexity forward. The portion of enamel preserved on the crown accords with the Pterosaurian type of tooth in its thinness, in the very delicate, irregularly wavy, sometimes branching, longitudinal ridges, on its outer surface; the dentine is compact, and is coated by cement at the base of the tooth.

PTERODACTYLUS WOODWARDI. Tab. II, figs. 3, *a*, *b*, *c*.

The specimen from Professor Sedgwick's collection, represented of the natural size in Tab. II, fig. 3, *a*, *b*, is a transverse fragment of the jaw of a Pterodactyle, from the Upper Green-sand of Cambridgeshire, showing a greater divergence of the side walls towards the alveolar or oral surface, and, consequently, greater breadth of that surface in proportion to the height or vertical extent of the part. Of the oral surface too small a portion is preserved to indicate whether it be palatal or mandibular. By the characters of the median ridge or groove pointed out in my former monograph, I incline to regard it as part of the upper jaw, corresponding in the proportions of height and palatal breadth with that of the *Pterodactylus Fittoni* (Tab. I, fig. 3, *c*, 'Monograph' for 1857), but coming from a part of the jaw further from the anterior extremity.

The fractured ends show the characteristic thinness of the compact, bony wall, and the large (air-?) cells occupying its substance.

The side wall, which is most entire, has been abraded (Tab. II, fig. 3, *b*), but the small portions of the preserved surface exhibit the smooth character of Pterosaurian bone. The fragment includes a pair of sockets, with the bases of their teeth. The latter show the usual elliptical, transverse section (fig. 3, *c*). The implanted base of the tooth extends three fourths of the way to the upper border of the jaw; it has a coat of cement half a line thick, with the outer surface longitudinally ridged, corresponding with the grooves of the socket. The direction of the socket shows that the tooth extended obliquely forwards and outwards as well as downwards.

Tab. IV, fig. 4, shows the part of the base and basal half of the crown of a tooth of a Pterodactyle, from the Upper Green-sand of Cambridgeshire, a little surpassing in size that of which the base is shown implanted in the socket of the

portion of jaw (Tab. II, fig. 3), and of that figured in Tab. I, fig. 6, *a*, *b*, *c*, of my former 'Supplement' (1857). The total length of the tooth (fig. 4) cannot have been less than 4 inches.

If the present fragment has belonged to an individual of the same species as that on the upper jaw of which the *Pterodactylus Fittoni* is founded, it shows such species to have attained more than double the dimensions indicated by the original specimens figured in Tab. I, figs. 3 and 4, of the 'Monograph' for 1857. Should the present fragment prove to belong to a distinct species, with the sides of the jaw meeting above, at a less acute angle, and with the wall of the outlet of the socket less prominent externally, such species may be indicated as the *Pterodactylus Woodwardi*, in honour of the founder of the Geological Collection of the University of Cambridge.

The mandible (Tab. I, figs. 6—10).

The portion of the right ramus of a lower jaw, or mandible, figured in the above-cited plate, may have belonged, by its size, to either of the gigantic Pterodactyles above specified as *Pt. simus* and *Pt. Woodwardi*. Its texture and configuration show it to have formed part of a Pterosaurian skeleton. It is the part of the ramus which answers to the angular, sur-angular, and articular elements in the *Pterodactylus suevicus*,* but with only a part of the sutures between the angular and sur-angular remaining on the inner side of the bone. The angle is partially fractured, but seems to have been not much produced beyond the articular concavity.

The ramus, as it extends forward from the articular part, at first diminishes slightly in breadth and depth, then increases in vertical, whilst continuing to decrease in transverse, extent.

The outer surface (fig. 7) presents, near the articular cavity, a shallow, longitudinal depression, bounded below by a rather sharp border; a broader and more shallow depression, the lower boundary of which is well defined, marks the more advanced part of the ramus. These depressions indicate the insertions of muscles.

Both the upper (fig. 9) and lower (fig. 8) borders are obtusely rounded, the latter being the thickest. Along the inner side of the fragment a longitudinal channel (fig. 6, *e*) extends near the lower border, the upper boundary of the channel being produced inwards, especially posteriorly (*b*); above this boundary there is a deep, longitudinal depression (*d*) partly filled with matrix, and probably communicating with the (pneumatic?) cavity of this part of the jaw-bone.

* Quenstedt, 'Ueber *Pterodactylus suevicus*,' 4to, 1855, tab. i, figs. 2, 4, 5.

The longitudinal depression (fig. 6, *d*) is bounded below by the angular element, or part answering to that marked 2 in *Pterodactylus suevicus*, and above by the sur-angular (*c*). This element appears to have coalesced with the articular one; but between the bone (*a*, *c*) and that marked *b* a true harmonia or toothless suture remains. The line below the letter *e*, in fig. 6, appears to be an accidental crack. The fractured anterior end of the fragment (fig. 10) indicates the extreme thinness of the wall of the bone, which consists of compact osseous substance. A part of the concave, articular, surface is shown at *a*, fig. 7.

A similar longitudinal depression on the inner side of the back part of the ramus, with its lower boundary produced as a ridge, and formed by the angular element (2), is indicated in the figure of the lower jaw of the *Pterodactylus suevicus* in Professor Quenstedt's memoir; according to the proportions of which jaw, the present comparatively enormous fragment would answer to almost the hinder half of that part of the ramus which has not united with its fellow to form the long symphysis, and it may be estimated as including one fourth of the entire length of the lower jaw, which would give to the Pterodactyle, yielding the present mandibular fragment, a head exceeding sixteen inches in length. It is probable, however, that the head of *Pterodactylus simus* was relatively shorter and thicker than in the smaller species of Pterodactyle.

The Basi-occipital (Tab. I, figs. 11, 12, 13).

A skull of the size above indicated would require an occipital condyle at least as large as that on the basi-occipital element figured in the above-cited plate. This condyle projects backward on a well-marked base too broad to be called a peduncle; the convexity is only hemispheric, with the transverse diameter predominating; its shape and position indicate great freedom of movement of the head upon the spine. There is no mark of a sutural surface for the exoccipitals on the expanded part of the bone (*b*); they were probably confluent, as in birds, with the basi-occipital, and have been broken away; the fractured surface (fig. 12, *b*) shows the large cancelli of this part of the occipital bone. The upper surface (*a*) indicates a wider foramen magnum, or neural canal, than that of the combined atlas and axis (fig. 14, *n*), and such a structure accords with the free and extensive movements of the head upon the spine indicated by the form and prominence of the condyle and its occipital cup (*c*).

Atlas and Axis (Tab. I, figs. 14, 15, and 16).

The anchylosed atlas and axis (figs. 14, 15, and 16) correspond in size with the above-described basi-occipital; they were obtained at the same time from the

same pit of the Upper Green-sand deposit near Cambridge. The condyloid ball (fig. 12, *c*) neatly fits the cup *c* of fig. 14, and most probably belonged to the same individual. All the characters described and figured in my paper on the 'Vertebræ of Pterosauria,'* and in a preceding monograph,† are repeated in the present larger specimens of the first and second neck-vertebræ. In the more transverse extension of the posterior articular ball of the axis (fig. 16, *b*) the present specimen agrees with the smaller of the two previously figured specimens of this part of the vertebral column.‡

Cervical Vertebræ (Tab. II, figs. 1, 2, and 4).

The middle (fourth or fifth ?) cervical vertebra of a Pterodactyle, corresponding in bulk with that indicated by the fossils above described and figured (Tab. I, figs. 1—16; Tab. II, fig. 3), agrees in the proportions of length and breadth more with the smaller vertebræ (Tab. II, figs. 14—17, vol. for 1857) than with the vertebræ (ib., figs. 7—11) described in my former monograph of that date. It shows the same posterior extension of the centrum (fig. 2, *b*, *p*) beyond the neural arch (*n*), but with somewhat greater divarication of the hinder processes (*p*) than in figs. 18 or 11 of Tab. II of the above-cited monograph. The present specimen very strikingly illustrates the characteristic breadth and depression of the centrum of the middle cervicals of the large Green-sand Pterodactyles. The neural canal (fig. 2, *n*) appears to be proportionally more contracted than in the smaller cervical vertebræ; it is relatively much smaller than in any bird, marking well the reptilian nature of the extinct flying air-breather. The anterior surface of the diapophysial productions of the forepart of the base of the neural arch is marked by a groove extending from above and within outwards and downwards. The whole base of the arch has coalesced with the centrum; the major part, with the neural spine and zygapophyses, has been broken away.

An oblique side view of the last cervical vertebra of a similar-sized Pterodactyle is given in Tab. II, fig. 4, showing the more produced diapophysis (*d*), perforated by the vertebrarterial foramen (*f*), indicative of the development in this vertebral segment of a rudimental rib, and of its coalescence with the other elements, the whole extending below the level of the under part of the centrum. Above and behind this foramen is that for the admission of air into the bone; it is of a similar size, and of a narrow, elliptical form. The posterior zygapophysis (*z*) is now raised to a higher level than the anterior one, indicating the sudden bend of the neck at this part. The posterior processes (*p*) are smaller and less

* 'Philosophical Transactions,' 1859, p. 165, pl. 10, figs. 28—34.

† 'Palæontographical Society,' vol. for 1857, pp. 7, 8.

‡ Compare Tab. I, fig. 16, with Tab. II, fig. 14, and Tab. IV, fig. 2, of the 'Monograph' of 1857.

produced; the body of the vertebra is narrower, but deeper, than in the more advanced vertebra (fig. 1). The posterior zygapophysis is surmounted by a tubercle.

Caudal Vertebræ (Tab. II, figs. 13—16).

The caudal vertebra, from the anterior half of the tail (figs. 13 and 14), presents a size corresponding with the proportions of the Pterodactyle given by the above-described neck-vertebræ; the neural arch and zygapophyses continue to be distinctly developed at this region of the tail. There is a foramen (*o*), leading into the substance of the neural arch, on each side of the back part of that arch, and near the corresponding outlet of the neural canal. In the more distal vertebra (figs. 15 and 16) the neural arch has sunk, and seems almost blended indistinguishably with the centrum, which is much longer than in the vertebræ nearer the trunk. The zygapophyses cease to be developed; but the articular, shallow cup and ball at the ends of the vertebra show that the tail retained its mobility, and was not stiffened or anchylosed as at the corresponding part in *Ramphorhynchus*.

The Sternum (Tab. II, figs. 7—12).

According to the very able and instructive summary, by M. V. Meyer, of the osteology of the best-preserved examples of the skeletons of Pterodactyles, those, viz., from the lithographic slates of the Jurassic (Mid-oolitic) series of rocks, the sternum is a compound bone, consisting chiefly of a symmetrical, keelless, broad plate,* having an anterior process answering to the episternal process in the crocodile,† and with distinct side parts, having articulations for a few bony, sternal ribs.‡ As to its resemblance, otherwise, to the sternum of mammals, birds or reptiles, in regard to the articular surfaces for the scapular arch, nothing has been, hitherto, determined.

* "Das Brustbein ist ein schwach gewölbtes knöchernes Schild, das breiter als lang, und daher eher dem Brüstbein der nur kümmerlich mit *Flügeln* versehenen Strauss-artigen Thiere beider Erdhälften, als dem in den Flug-begabten Vogeln zu vergleichen ist. Es zeigt keinen Kiel öder Gräth, und Man könnte daher glauben, das die Stelle zum Ansatz eines kräftigen Flugmuskels fehlt, die Pterodactyln keine gute Flieger gewesen wären." ('Reptilien aus dem Lithographischen Schiefer,' fol., 1859, p. 17.)

† "Am Brustbein der Pterodactyln wird ein vorderer Forsatz wahrgenommen, der den Kiel ersetzt und den Brustmuskeln als Anheftungsstelle gedient haben wird. Dieser Theil erinnert au den Forsatz am Brustbein des Crocodils." (Ibid., p. 18.)

‡ "Bei *Ramphorhynchus Gemmingi* fand ich ausser den gewohnlichen Brustbein nach eine Platte mit Brustrippe welche die Verbindung mit den Kückenrippen unterhalten haben werden und wie in den Vogeln knöchern waren." (Ibid., p. 18, tab. x, fig. 1.)

The rich repository of remains of gigantic Pterosauria in the Upper Greensands of Cambridgeshire have added valuable evidence on these important points, and demonstrate a nearer approach to the keeled character of the breast-bone of flying birds than the specimens of the smaller species described in the undercited works appear to demonstrate. By the kindness of Professor Sedgwick, I am enabled to compare the specimens of portions of the sternum acquired by the Woodwardian Museum with that which has recently been purchased by the British Museum. The best of these specimens consist of little more than the thicker and stronger, contracted forepart of the breast-bone (Tab. II, figs. 7, 8, and 9), broken away from the thin, expanded, fragile plate (*h*), of which it principally consists, and of which remains or impressions have been preserved in a few slabs of fine-grained stone of the Oolitic series, such as the lithographic slate; that of *Pterodactylus suevicus* * showing the posterior border of the symmetrical plate to be convex and entire, not notched or perforated, as in many birds. The forepart of the sternum of the gigantic Pterodactyle from the Cambridge Green-sand includes the major part of the anterior process, and also the pair of articular facets for the coracoids. The keel-like process in the specimen (Tab. II, figs. 7, 8, 9, *b*, *e*, *f*) is continued forward from that articular region (*d*, *c*), for an extent equal to the depth of the bone at the same part; but the process is not entire. Its base is gently convex at the sides, from the middle and thickest part of which it gradually narrows to a ridge, of about a line or less in thickness at both the upper and under margins; the extreme forepart being broken away, prevents the determination of the precise extent or contour of that end, but the convergence of the preserved parts of the upper and under margins indicate a convexly rounded termination (fig. 7, *e*). There is a gentle depression on each side of the beginning of the upper part of the ridge, which ridge is continued from a thickening or tubercle (figs. 7, 8, *b*), bounding anteriorly a small, deep, transversely oval depression (*d*) between the two articular surfaces for the coracoids (*c*). This tubercle answers to what I have termed the "manubrial process" in the sternum of birds,† and the above pre-coracoid part of the sternum answers to that process, confluent below, as in *Aptenodytes*, with the produced "keel." This, however, in *Pterodactylus*, quickly loses depth as it extends backwards along the mid-line of the under part of the sternum, some way behind the articular region, and has not quite subsided at the forepart of the expanded body of the breast-bone (fig. 9, *f*), from which the rest of the shield-like plate has been broken away. The sides of the post-coracoid part of the keel are gently concave; the lower border of the keel is first convex, then concave to near its posterior termination, both in a very feeble degree (fig. 7, *e*, *f*). Each of the

* Quenstedt, 'Ueber *Pterodactylus suevicus*, im Lithographischen Schiefer Würtembergs,' 4to, 1855.

† Art. "Aves," 'Cyclopædia of Anatomy and Physiology,' vol. i, 1836, p. 282, fig. 129.

articular surfaces for the coracoid (figs. 7 and 8, *c*, *d*) is sub-triangular, convex transversely, concave in the opposite direction, with the lower angle continued down upon the side of the thickest part of this anterior portion of the sternum. The back part of the articular surface rises higher than the front, so that the general aspect of the surface is obliquely upward, forward, and outward. The two surfaces are separated by a non-articular depression (*d*), of the breadth of one coracoid surface; this depression is bounded, like the sella turcica of the human sphenoid, by a transverse rising or ridge of bone (fig. 7, *a*), continued between the hinder angles of the two articular surfaces, and in front by the manubrial tubercle (*b*), from which the upper border of the produced keel is continued. The sternum contracts behind the articular region at *g*, figs. 8 and 9, and then expands rapidly in the horizontal direction, to form the broad, lamelliform body of the bone (*h*), which, in *Pterodactylus suevicus*,* appears to have been almost semicircular in shape, and to have extended backward beneath about one half of the thoracic abdominal cavity. The upper surface of the forepart of the sternal plate is concave, and it becomes flatter as it expands. The lateral and lower surfaces are also concave vertically, with linear markings, showing the implantation of the pectoral muscles that filled those concavities on each side the keel. Sufficient thickness of the bone remains at the fractured posterior part (*f*), where the keel has not subsided, to show the widely cancellous, and seemingly pneumatic, texture of the bone.

The similar, but smaller and more mutilated, portion of a sternum of a Pterodactyle (Tab. II, figs. 10—12) shows the same form and position of the coracoid articular surfaces, the non-articular intermediate depression, the lateral emarginations or contraction of the sternum behind the part supporting the coracoids, and the backward extension of the keel beneath a certain proportion of the expanded body of the sternum, forming the hollows for the lodgement of the pectoral muscles.

A sternum of the shape and proportions above described plainly indicates pectoral muscles of great bulk and strength, by the extent of origin it afforded to them, and by the depth of the depressions they filled on each side of the keel; but to what purpose the limbs moved by those muscles were put is best inferred from the characters of the bone into which they were inserted. If, however, the peculiar development of the fore limbs of the Pterodactyle had not been known, the evidence of a pneumatic or widely cancellous structure in the thicker forepart of the breast-bone would have suggested a power of locomotion in its original possessor akin to that of the class to the sternum of which that of the Pterodactyle makes, upon the whole, the nearest approach.

It is true that the sternum is broad and shield-shaped in the Apteryx and other land-birds devoid of the power of flight; but this form, together with the

* Quenstedt, op. cit.

strong coracoids and their articulation with the sternum, relates, in them, to the mechanism of respiration. The ossified sternal ribs, with their articulations to the sides of a broad sternum, indicate a like function of the breast-bone in the Pterodactyle, viz., to expand the thoracic abdominal cavity, when such plate of bone, with attached but jointed sternal ribs, was pressed down by the coracoids.* The superadded keel, co-extended anteriorly with the connate manubrial process of the sternum of the Pterodactyle, plainly bepeaks, however, additional functions; but these might have been, as M. Von Meyer suggests, the same as in the penguin, or even in the mole. And, at this point, the physiologist in quest of the locomotive relations of the sternum, would pass to the comparison of the humerus and other bones of the fore limb; or, failing those, to a more minute scrutiny of the texture of the breast-bone of the Pterodactyle. It is almost superfluous to remark that the evidence of the fore limbs had shown the Pterodactyle to have been a flying animal long before anything was precisely known as to its sternum.

The development of the interpectoral process or keel of the sternum in the Pterodactyle exceeds that in any of the bat tribe; and it may be confidently concluded that the flight of the winged reptile might have been, at least, as swift and of as long continuance as in the *Pteropi*. But, viewing the pneumaticity of the bones of the Pterodactyle, and the relatively greater and more continuous development of the interpectoral crest of its sternum, I am led to believe it to have been a creature of more extensive, continuous, and powerful flight than is now enjoyed by any bat; and the Pterodactyles may at least have been as capable of migration as the great frugivorous *Chiroptera*. The structural affinities, however, of the Pterodactyles to the cold-blooded air-breathers, and their analogy, in wing-structure, to the bats, indicate that they might have possessed the faculty of becoming torpid, and of so existing during a period when their food in a given locality was not attainable.†

* From the appearances presented by the crushed specimen of *Pterodactylus Gemmingi*, imbedded in a slab of lithographic slate, I believe that the part of the sternum showing those articulations has been accidentally separated from the rest of the fractured bone. (See Von Meyer, Tab. x, op. cit.) The estimable author concludes that the marginal portion of sternum, with articulations with ossified sternal ribs, was originally distinct from the body or main plate of the sternum: but the plate of the specimen he describes shows fractures and some mutilation of the bones.

† The inferences from what was previously known as to the structure of the sternum of the Pterodactyle are thus expressed by M. H. v. Meyer, in his summary of the knowledge of the Pterosauria, in 1859: "Es zeigt keinen Kiel oder Gräthe, und man könnte daher glauben, dass, da die Stelle zum Ansatz eines kräftigen Flugmuskels fehlt, die Pterodactyln keine guten Flieger gewesen wären. In dem Mangel eines Kieles scheint indess nur eine Andeutung zu liegen, dass die Thiere keine Vögel waren. Eben so wenig werden sie Wanderthiere gewesen seyn, und bedurften daher auch keines so starken Brustmuskels. Das Brustbein der Fledermäuse gleicht sogar durch die Gegenwart eines Kiels mehr dem in den Vögeln

In no other reptile does the sternum present coracoid articulations so shaped and so placed as in the Pterodactyle. The Crocodilia, in which, as in Pterosauria, the clavicles are wanting, show the broad, sternal margins of the coracoids ligamentarily attached to the middle of the lateral border of the sternum.

In bats the obtuse, sternal ends of the clavicles are applied to protuberances of the manubrium above the articulations of the first pair of ribs. Only in birds are distinct synovial articular cavities provided for the coracoids, which, in the main, are situated and shaped as in the Pterodactyle. The differences are these: the concavity and the convexity being (as, *e. g*, in *Aptenodytes*), the same, the bent grooves so formed are much longer than in the Pterodactyle, with a concomitant greater expansion of the ends of the bones they firmly lodge. The coracoid grooves are divided by a non-articular, median depression in *Aptenodytes*, but this, in some other birds, is wanting, the coracoid grooves decussating across the middle line, *e. g.*, in the Heron.* There are various minor modifications of the coracoid grooves in the breast-bone of birds.

The marked distinction in the breast-bone of the Pterodactyle is its compression behind the coracoid articulations, and the distinct commencement of the shield-like expansion behind that articular part.

In most birds the "manubrium" projects from the mid-space between the coracoid grooves, and is distinct from the "keel;" in some it is bifurcate; in the penguins it is as little developed as in the Pterodactyle, and is as directly continuous or connate with the forward production of the keel. In this production *Aptenodytes patachonica* most resembles, amongst birds, the Pterodactyle. The parts are homologous, and if we name that production the forepart of the keel of the breast-bone in the aquatic bird, we must apply the same name to it in the Pterodactyle; only in the latter the keel subsides sooner beneath the expanded part of the sternum.

In the Crocodilia the broad, thin, sternal borders of the coracoids are attached by fibrous substance to the fibro-cartilaginous, or, in old animals, partially

Es besitzen aber auch die Maulwürfe am brustbein diesen Kiel, der daher nicht unbedingt als ein Zeichen des Flugvermögens gelten kann; er setzt eigentlich nur starke Brustmuskeln voraus, die daran befestigt waren. Selbst in den Schwimmvögeln die nicht zu fliegen vermögen ist der Kiel vorhanden für starke Brustmuskeln, die hier zum Schwimmen eben so nöthig sind wie dem Maulwürf zum Graben. . . . . Aus diesen Betrachtungen ergiebt sich, dass der Pterodactylus nach der Beschaffenheit seines Brustbeins weder ein eigentliches Wasserthier, noch ein Gräber war, vielmehr ein Thier der Luft." ('Reptilien aus dem Lithographischen Schiefer,' &c., fol., p. 17.)

Professor Quenstedt, however, seems to me to have rightly appreciated the homology of the forepart of the sternum and the physiological deductions from it: "Der Kamm springt vorn einen halben Zoll weit über die Fläche des Knochens hinaus, gibt daher Beweis genug, das das Thier fliegen konnte." (Op. cit., p. 44.)

* 'History of British Fossil Mammals and Birds,' 8vo, 1846, p. 556, fig. 236.

ossified, plate, representing the sternum of struthious birds. The bony sternum, or "episternum," is long, narrow, and depressed; it is considerably produced in advance of the coracoids, but this produced part is flattened horizontally. If it be compared with the pre-coracoid part of the sternum in the Pterodactyle or penguin, it is not more like the one than the other. In the main, the Pterosaurian breast-bone, like the scapular-arch, is formed on the ornithic type, but the post-coracoid, lateral emarginations are distinctive Pterosaurian characters.

The Humerus of Pterodactylus (Tab. III).

The fragile texture of the bones of the Pterodactyle, and the consequently crushed or broken state in which those of the wings more especially have hitherto been usually found, have precluded any precise description or figures of the articular surfaces, or of the configuration of the extremities of these bones. And yet such particulars are absolutely requisite for defining the resemblance of the Pterosaurian humerus to that of the bird and reptile, and for acquiring this element in the determination of the degree of affinity or relation of the Pterosauria to those classes respectively.

The remains of the very large species of Pterodactyle from the Cretaceous formations of Kent and Cambridgeshire have furnished materials for advancing this desirable knowledge in regard to the structure of the vertebræ,* and I have now similar means of contributing more precise information respecting the structure of the proximal end of the humerus than has hitherto been possessed. For the subjects of this study and comparison I am chiefly indebted to Professor Sedgwick. But, in proceeding to impart the results, I must premise some notice of the character of the humerus in birds, in which I shall avail myself of the terms indicative of aspect and position proposed by Dr. Barclay, in his 'Anatomical Nomenclature.'

Proximal signifies the upper, *distal* the lower, ends of the bone, as it hangs in man; *anconal* is the posterior, *palmar* the anterior, surface, as when the palm of the hand is directed forward; *radial* is the outer, *ulnar* is the inner, side, according to the same position of the human arm and hand. *Proximad, palmad*, &c., are adverbial inflections, meaning towards the proximal (upper) end, and towards the palmar (anterior) side.

In the bird, then, the humerus has a smooth shaft, sub-elliptic in transverse section, with expanded ends, the proximal one being the broadest. Lengthwise the bone is gently sigmoid, the proximal half being convex palmad, the distal half

* Phil. Trans., tom. cit.

concave, with the plane of the terminal expansions vertical, as the bone extends along the side of the trunk from its scapulo-coracoid articulation backward, in its position of rest.

The head of the humerus is an elongate, semi-oval convexity (Tab. III, fig. 8 *a*), with the long axis transverse from the radial to the ulnar sides (vertical, as naturally articulated), and with the ends continued into the upper (*b*) and lower (*c*) crests. Of these, the upper one (*b*, figs. 6—8), in the natural position of the bone, is on the same side as the radius, the lower, more tuberous one (*c*), is on the same side as the ulna; the one marks the "radial" side, the other the "ulnar" side, of the bone. The side of the humerus next the trunk answers to that called "anconal" (fig. 7), the opposite side to that called "palmar" (fig. 6).

The expanded, proximal part of the shaft on the palmar side (fig. 6) is concave across, convex lengthwise; on the anconal side (fig. 7) it is convex across to where the ulnar ridge (*c*) bends anconad near the pneumatic orifice (*p*).

The radial crest (*b*) answers to the "greater tuberosity" and to the "pectoral" and "deltoidal ridges" in mammals; the "ulnar" crest (*c*) to the "lesser tuberosity," and the ridge for the "latissimus dorsi," in mammals.

In a few exceptions the shaft of the humerus is almost cylindrical, in still fewer (*e. g.*, *Aptenodytes*) it is flat.

In the vulture (*V. monachus*), the ulnar crest forms a thick tuberosity at its proximal end (fig. 7, *c*), projecting anconad, and overarching the "pneumatic" foramen (*p*); it descends a short way obliquely palmad, decreasing in breadth, but still thick, convex, and terminating obtusely (fig. 6, *c'*). The radial crest (fig. 6, *b*) better merits the name; it extends twice the length of the ulnar one, down the shaft, to the palmar side, towards which the whole crest is slightly bent; its margin describes a very open or low, obtuse, angle at its middle part. A ridge (*r*) upon the palmar side of its distal half indicates the boundary of the insertion of the pectoralis major into the crest. At the middle of the anconal surface of the proximal part of the shaft there is a low, longitudinal ridge (*l*).

At the distal part of the humerus a ridge on the radial side of the palmar surface, and a rising of the bone on the ulnar side of the same surface, diverge to the opposite angles or tuberosities of the expanded end of the bone; they include a shallow, sub-triangular concavity above the articular surfaces. These are two, and are convex.

The radial surface is a narrow, sub-elongate convexity, extending from near the middle of the palmar surface obliquely to the lower part of the radial tuberosity, where the convexity subsides; it is very prominent at its palmar end, with a groove on each side, the deeper one dividing it from the ulnar, articular convexity. This is of a transversely oval or elliptical shape, most prominent

palmad; all the part of the end of the humerus forming the two articular convexities is as if bent toward the palmar aspect. The ulnar end of the ulnar convexity is bent, and continued anconad to that end of the ulnar tuberosity. An oblique, longitudinal channel divides the anconal end of the radial tuberosity from an almost longitudinal ridge, which is nearer the middle of the anconal side of the distal end of the humerus; a similar, but shorter, longitudinal ridge or rising of bone, terminates in the anconal part of the ulnar tuberosity. Between the above almost parallel ridges the anconal surface is nearly flat transversely; it is traversed along the middle by a low, narrow, longitudinal ridge. Lengthwise the bone is here convex.

The differences in the humerus of different birds are seen chiefly in the forms and proportions of the proximal crests; the radial one in the *Columbidæ*, *e. g.*, is shorter and more produced than in most birds of flight. The humerus in the swift and humming-bird is distinguished by special modifications.

In the crocodile (Tab. III, figs. 9—12), the articular head of the humerus (fig. 12, *a*) is a transversely elongated, sub-oval convexity; it is continued upon the short, obtuse, angular prominence (*c*), answering to the ulnar crest or tuberosity in the bird. The radial crest (fig. 9, *b*) begins to project from the shaft at some distance from the head of the bone; it is shorter, thicker, more prominent, and projects more directly palmad than in the bird. The humerus presents a similar sigmoid flexure lengthwise to that in the bird, but the ulnar contour of the shaft, as it descends from the ulnar end of the head of the bone, describes a concave line to the ulnar condyle; the radial contour is sigmoid, and not affected by the radial crest, as in the bird. There is a longitudinal ridge (fig. 10, *d*) on the anconal surface close to the radial border.

The humerus of the Pterodactyle (ib., figs. 1—5) is shorter in proportion to the expanse of its proximal end than in either the bird or crocodile, and it appears to have a straighter shaft. It conforms at its proximal end more with the Crocodilian than the Avian type. The ulnar crest, or tuberosity (*c*), is rather more prominent and better defined than in the crocodile, but the radial crest (*b*) is much more developed than in either the crocodile or bird. It resembles that of the crocodile in being more directly bent palmad, or what would be outward in relation to the side of the trunk, in the natural position of the bone at rest.

The crest begins, above, at the radial and palmar end or angle of the articular head of the bone, and rapidly expands, bending palmad, with a base co-extensive with one fifth of the length of the humerus, inclining, as it descends (fig. 3), to the palmar side, and ending below by a rough tuberosity projecting at a right angle from the shaft of the bone; the lower sharp margin (fig. 1, *b'*) of the tuberosity passes by a quick curve, and subsides upon the cylindrical shaft. The palmar surface of the proximal part of the humerus, by the production in that direction of the ulnar

tuberosity, but more especially by the direction of the large, radial crest (*b*), is more concave across than in birds. Between *b* and *c*, *e*, *g*, in fig. 1, it is gently convex lengthwise, and is very smooth.

A longitudinal ridge (fig. 1, *r*), along the distal half and palmar side of the base of the radial crest, indicates, as in birds, the insertion of the strong and large pectoral muscle.

The articular head of the bone is reniform, not uniformly convex, as in birds, but slightly concave between the beginnings of the radial and ulnar crests or processes on that moiety of the head next the palmar side (fig. 3, *a*). At the opposite (anconal) side (fig. 2, *a*), the head projects slightly beyond or overhangs the shaft, the upper part of which, on the anconal side, is slightly concave lengthwise, very convex across, more so than in birds, and without trace of the median longitudinal ridge (*l*, fig. 7). It is equally devoid of the ridge which, in the crocodile (fig. 18, *d*), runs close to the radial side of the anconal surface.

The shaft is more cylindrical than in birds. The pneumatic foramen (figs. 3, 5, *p*) is situated a little below the radial end of the head of the bone, on the palmar side of the bone; in the vulture, and most birds of flight, it is situated on the opposite side (fig. 7, *p*). The pneumatic texture of the shaft is as well marked as in any bird of flight.

In looking directly upon the palmar side of the humerus in the bird one has an oblique, foreshortened view of the radial crest, the base of which lies wholly along the radial margin. Taking the same view of the humerus of the Pterodactyle as in Tab. III, fig. 3, we look almost directly upon the edge of the radial crest (*b*, *b'*), the base of which has inclined below from the radial upon the palmar surface. A corresponding view of the humerus of the crocodile (fig. 11) shows the whole base of the radial crest on the palmar surface, clear of the radial border, and the opposite side of the crest to that in the bird is obliquely brought into view. (In the figure 11 the radial side of the shaft is rather too much turned towards the eye.)

In the position and shape of the radial crest the Pterodactyle is between the bird and the crocodile; in the transverse extent of the crest it exceeds both. The crest differs in extent and shape in different species of the Pterodactyle. In fig. 1 the ulnar side of the shaft is turned so far towards the eye as to permit the whole breadth of the radial crest (*b*) to be seen. The degree to which the radial crest projected in the humerus of the large Cretaceous Pterodactyle (Tab. III, fig. 1) is only shown at its lower part, the upper, thinner portion being broken away. Relatively to the size of the head of the bone, the extent of the base is greater than in the smaller species of Pterodactyle, a corresponding portion of the humerus of which is represented in fig. 5, from the same aspect as fig. 1. The

extent of the base of the radial crest in fig. 5 corresponds with that of *Pterodactylus suevicus.**

In *Ramphorhynchus Gemmingi* the radial crest, with a similar short origin, has a remarkable transverse extent, and expands at its termination, so that both upper and lower margins are very concave.† The latter is of much greater relative extent than in the large Cretaceous Pterodactyle (Tab. III, fig. 1). The Wealden Pterodactyle (*Pter. ornis*) resembled *Ramphorhynchus* in the proportions of the radial or outer process (*g*, fig. 5, 'Quart. Journal of the Geol. Soc.,' 1845, p. 99).

The determination of the homologies of the processes from the proximal end of the humerus of the Pterodactyle with those in the bird and crocodile enables one to recognise the specimen (figs. 1—3 and fig. 5) as part of the right humerus.

Fig. 4 is part of the left humerus, from the Upper Green-sand of Cambridgeshire, but was drawn upon the stone without reversing, to facilitate its comparison with fig. 1, from the Middle or White Chalk of Kent, which it resembles in the extent of origin of the radial ridge (*b*).

Carpal Bones (Tab. II, fig. 6; Tab. IV, figs. 5—9).

The two bones (Tab. IV, figs. 5, 6, and figs. 7—10) correspond in size so much more with that of the distal extremities of the radius and ulna than with that of the same part of the tibia, as to leave a conviction that they are carpal bones, and they afford instructive evidence of the characters of those bones in the Pterodactyle. Specimens of more or less entire, but dislocated, skeletons of the smaller kinds of Pterodactyle from Oolitic strata, especially that of *Pterodactylus suevicus* from the lithographic slates of Wirtemburg,‡ and that of *Ramphorhynchus Gemmingi* from the same formation at Eichstadt,§ have demonstrated the presence of at least two large carpal bones, with one or two smaller ones, the two carpals forming a first and second row; but the figures are too small and indefinite to permit the matching with them of either of the larger and probably better-preserved carpal bones from the Cambridge Green-sand.

The first to be described is subdepressed, subtriangular in shape, with a general tendency to convexity on one articular surface (Tab. IV, fig. 8), and to concavity

* Quenstedt, op. cit., tab. i, *cr*, *cl*.

† H. v. Meyer, op. cit., tab. ix. A. Wagner, 'Fauna des Lithogr. Schiefers,' 4to, 1858, taf. xvi.

‡ Well described and figured by Professor Quenstedt, in his treatise 'Ueber *Pterodactylus suevicus*,' 4to, Tubingen, 1855.

§ H. v. Meyer, op. cit., tab. ix, fig. 1.

on the opposite surface (fig. 7); but both these surfaces are irregularly undulated, as shown in the figures; the more concave surface being also impressed by a deep hemispheric pit. I conjecture that this bone formed the proximal part of the carpus, and that the pit may have received a process of the distal end of one of the antibrachial bones. The opposite, probably distal, and more convex surface (fig. 8) is divided into two slight convexities, by a shallow, wide channel, crossing the bone obliquely. The convexity (*a*) meets the concave surface on the other side of the bone (*e*, *f*) by their convergence to the basal border or margin, which presents a slight notch. The opposite end of the bone forms the obtuse apex (*d*), which is a little bent down towards the concave side. On this side (fig. 7) the notch is continued into an angular channel, which divides the two shallow, concave surfaces (*e* and *f*) occupying the basal half of this surface; a little nearer the apex than the middle of the bone comes the hemispheric pit, with a small depression on one side of it.

Fig. 9 shows the thickest or deepest, non-articular side of the bone, sloping to the end of the facet (*f*), and with the apical tuberosity (*d*) at the opposite end.

Fig. 10 is taken looking upon the convex surface from the notched base (*a*).

Fig. 8 may correspond with the surface of the carpal bone in *Pterodactylus suevicus*, marked 1, in the bones of the left wing in Professor Quenstedt's Plate; and the side view of the same bone in the carpus of the right wing gives an indication of the produced apex. The outline of the large proximal carpal in *Pterodactylus* (*Ramphorhynchus*) *Gemmingi*, in M. v. Meyer's Plate, accords in a general way with the profile of the narrower side of the present bone, which, for the convenience of indication and description, might be called the "scapho-cuneiform." I have no proof, however, from knowledge of its precise connexions, of the accuracy of this determination; but strongly suspect that the bone may represent more than one of the proximal carpals in the mammalian wrist, and probably the two proximal bones in the carpus of the crocodile.

In Tab. II, fig. 6, a scapho-cuneiform bone is figured, which, from its size, might belong to *Pterodactylus simus;* it differs from that in Tab. IV, fig. 7, not merely in size, but, apparently, in a greater relative breadth of the surfaces (*e* and *f*); their margins forming the base of the triangle have been, however, abraded.

The second large wrist-bone (Tab. IV, figs. 5 and 6), if the foregoing be rightly compared, will match with the carpal bone articulating with the proximal end of the metacarpal of the fifth or wing-finger in the plates of *Pterodactylus suevicus*, and of *Ramphorhynchus Gemmingi*, above cited; and it will consequently answer to or include the "unciforme," by which name it will be here described and figured.

Both proximal and distal surfaces show well-defined, concave articulations. On the more concave surface (fig. 5) there is an oblong, articular depression (*g*), continuous at the margin (*h*) with a surface on the opposite side of the bone; a more irregular undulated channel, deepest at the middle part (*i*), occupies the rest of the surface, but the end of the bone opposite (*h*) has been broken away. Fig. 6 shows two shallow, articular channels (*k* and *l*), partly divided near the end (*h*) by a tract of non-articular surface.

In birds the base of the metacarpal of the digitus medius has the "os magnum" connate therewith, it also becomes confluent with the bases of the second and fourth metacarpals. Between this compound bone and the antibrachium two distinct carpal bones partially intervene, being wedged between the metacarpus and antibrachium, one on each side. The Pterodactyle, in the complete separation of the metacarpus from the antibrachium, by two successive carpals, answering to the two rows, adheres more closely to the Reptilian type; but differs in the much greater expanse and complexity of the carpals, and in their minor length.

Ungual Phalanx (Tab. IV, figs. 11 and 12).

The ungual phalanx (Tab. IV, figs. 11 and 12), accords in size with that of the limb indicated by the carpal bones (figs. 5—10). The articular surface presents two trochlear concavities, extended vertically, narrow transversely, divided by a median ridge; the upper angle is rather produced; below the trochlea is a small depression, and below this the bone projects in the form of the rough protuberance for the flexor tendon. On each side of the phalanx is the curved vascular groove, beneath which, in some specimens, the bone slightly expands. In one specimen a second, more shallow groove is shown on one side, nearer the upper margin of the bone.

Order—*SAUROPTERYGIA*, *Owen*.*

Genus—Polyptychodon, *Owen*.

Polyptychodon interruptus, *Owen*.

In the 'Monograph of the Fossil Reptilia of the Chalk Formations,' p. 200,† certain dental and osteological characters of a large extinct Saurian were described and figured, confirmatory of the distinct generic form of reptile, for which had been proposed the name *Polyptychodon*,‡ having reference to the numerous longitudinal ridges and grooves, giving a minutely folded surface to the enamel covering the crown of the tooth. In my 'Report on British Fossil Reptiles,' the genus was referred to the 'Sauria incertæ sedis,' no other parts save the teeth being then (1841) known. A few years later a portion of jaw was discovered in the Lower Chalk of Kent, showing that the teeth were implanted in distinct sockets, as in the *Crocodilia*. This specimen I described and figured in the work of my friend, Mr. Dixon, entitled 'The Geology and Fossils of the Tertiary and Cretaceous Formations of Sussex.'§

Some large fossil bones from a Green-sand quarry near Hythe, Kent, described in the above-cited 'Monograph on the Fossil Reptilia of the Cretaceous Formation,'‖ as probably belonging to *Polyptychodon*, showed that "the pubis and ischium approached somewhat to the Plesiosaurian type."¶

Cranium and Teeth (Tab. IV, figs. 1—3).

I have lately been favoured by Mr. George Cubitt with the inspection of part of the cranium, including portions of jaws with teeth, of *Polyptychodon interruptus*, discovered in cutting a railway tunnel through the Chalk formations near Frome, Somersetshire, which gives further evidence of the Plesiosauroid

* Report of the British Association, 1859, p. 153.

† Volume of the Palæontographical Society, 4to, for 1851.

‡ This genus was established, on the characters of detached teeth from the Chalk, in the author's "Report on British Fossil Reptiles," 'Trans. of the British Association,' 1841, p. 156.

§ 4to, 1848, tab. xxxviii, fig. 3.

‖ Monograph, cit. pp. 201—209.

¶ Ibid., p. 206.

affinities of the genus, in the presence of a large oblique "foramen parietale" between the frontal and parietal bones (Tab. IV, fig. 1, *p*).

The parietal bone (7) is much compressed, and developes a sharp and rather lofty median crest behind the foramen (*p*), which crest divides the temporal fossæ (*t*, *t*). Behind this crest the parietal bone expands transversely, and assumes a tri-radiate form, the two transverse rays uniting with the mastoids (8, 8). These are very powerful bones, bounding the outer and back part of the temporal fossæ; they are smooth and slightly convex above, rough and slightly concave at the back part near the angle, where a surface is thus formed for the attachment of some powerful muscle. The part of the mastoid which curves forward from the angle to form the back part of the zygomatic arch, becomes compressed, and terminates above in a ridge (*r*). The substance of the mastoid is extensively excavated, apparently for the upper part of the acoustic chamber.

The frontal bone (11) is overlapped behind by the parietal, and appears to have been divided by a median "harmonia," or smooth suture; the receding halves of the frontal behind, as they pass beneath the parietal, form the forepart of the foramen parietale. The back part of the foramen is formed by a notch in the forepart of the single and undivided parietal. The canal from the foramen extends obliquely downward and backward. The long diameter of the foramen is 1 inch; the breadth of the back part of the cranium is 16 inches; the breadth of the back part of each temporal fossa is $6\frac{1}{2}$ inches. The power of the muscles acting upon the lower jaw must have been very great.

A portion of a symmetrical bone, 10 inches long, which formed the upper median part of the face, anterior to the orbits, represents part of an undivided nasal bone (15) and shows that bone to have been long, narrow, straight longitudinally, convex transversely above, as if the upper part of the face had been traversed by a low, obtuse, median rising.

In most of these characters may be discerned a closer affinity to the Plesiosauroid than to the Crocodilian type.

The expanse of the temporal fossæ equals that in the *Plesiosauri* and *Teleosauri*, but no species of the latter genus of *Crocodilia* has presented the "foramen parietale," whilst it is a constant character in the *Plesiosauri*, *Ichthyosauri*, and *Labyrinthodontia*; many of the modern lizards also present the same foramen. The portion of the upper maxillary bone, figured of the natural size at fig. 2, Tab. I, shows the same obliquity of the separate sockets of the teeth as exists in those at the forepart of the bone in certain *Plesiosauri*, and the small separate foramina (*o*, *o*), at the inner and back part of the large alveoli, which had been perforated by the summits of the successional teeth, are of plesiosauroid character. I have seen portions of jaws of *Plesiosaurus megacephalus* in which the appearance of a double row of teeth was caused by

the length of the protruding summits of the new teeth before they displace the old, when they are pushed, causing absorption of the intervening osseous bar, into the large sockets of the teeth they replace.

The crown of the teeth of *Plesiosaurus* is, moreover, one which that of the teeth of *Polyptychodon* (fig. 3) resembles in the ridged enamelled surface and sub-circular transverse section; but the teeth of true *Plesiosauri* are proportionally longer and more slender, whilst those of *Polyptychodon* in the proportions of the crown more resemble the teeth of the crocodilian genera *Goniopholis* and *Madrimosaurus*.

The microscopic structure agrees equally with the plesiosauroid and crocodilian modifications of the dental tissues. In Tab. I, fig. 3, *b* shows the shape of the base of the deeply implanted tooth, at the part where it had been broken in one of the specimens (*a*), accompanying the portion of cranium from the Lower Chalk at Frome. Fig. 3 is a more entire tooth of the same individual.

Cervical Vertebra (Tab. V, figs. 1 and 2).

I next proceed to offer other evidences tending to show the affinity of *Polyptychodon* to *Plesiosaurus*. In the Upper Green-sand deposits near Cambridge, and in the Neocomian formations of similar age at Kursk, south of Moscow, large vertebræ of the Plesiosauroid type have been discovered, together with teeth of *Polyptychodon*, which vertebræ I believe to belong to that genus.

The centrum of a cervical vertebra, from the Cambridgeshire Upper Green-sand (figured in Tab. V, figs. 1 and 2), measures 4 inches 3 lines in length, 5 inches 3 lines across the terminal articular surface, and 7 inches in total breadth, including the transverse processes (*pl*, *pl*). Each of these projects about an inch from the side, rather nearer the fore than the back part, of the vertebra, and terminates in a flattened surface for the ligamentous articulation of the cervical rib, which surface measures 2 inches 3 lines by 2 inches in its diameters (fig. 1, *pl*). The articular surfaces of the centrum are nearly flat.

This vertebra, with which no other teeth save those of *Polyptychodon*, from the same formation and locality, agree in size, thus presents the essential characters of the neck-vertebræ of *Nothosaurus* and *Plesiosaurus*, and must be referred to the order *Sauropterygia*.* The specimen is preserved in the Woodwardian Museum at Cambridge. It was obtained from the Green-sand

* See the "Classification of Reptilia," 'Reports of the British Association,' 1859, p. 159, and 'Palæontology,' 8vo, 1860, p. 209.

phosphatic-nodule works at Haslingfield, about four miles from the town of Cambridge.

In a collection of Upper Green-sand fossils from the vicinity of that town, lately purchased by the British Museum, there is the centrum of a dorsal vertebra of corresponding dimensions. It presents the usual characters of the Plesiosauroids; the articular ends are very slightly concave, with a moderate prominence in the middle, of a subcircular form, about the size of a crown-piece. The sides are gently concave lengthwise; the under surface is so in a less degree; this non-articular surface is smooth at the middle part, with longitudinal, irregularly wavy ridges and grooves for an inch at the margin, which are well defined; this roughness indicates the attachment of the fibres of the capsular ligament. The fore-and-aft diameter of the centrum is less at the summit than at the base; here it measures 4 inches 6 lines; along the neural canal it is 4 inches; the smooth tract caused by the impress of this canal is 6 lines across the narrowest part, and 2 inches across the widest end. The neurapophysial pits are shallow, with a rugged surface 3 inches 6 lines long by 1 inch 9 lines in diameter; the small part of the upper surface of the centrum not covered by the neurapophysis is at the end where the neural canal is widest, and which is most probably the hinder end; there are two venous foramina on one side and three on the other side of the middle of the lower surface of the centrum. The breadth of the articular surface is 6 inches 3 lines; its depth, or vertical extent, the same.

The same conformity, in regard to their proportional size, characterises the teeth of *Polyptychodon* and the associated large Plesiosauroid vertebræ from Kursk. I am indebted to the able engineer and zealous palæontologist, Colonel Kiprianoff, for the opportunity of examining the specimens discovered by him in that locality.

The centrum of one of these vertebræ belonging to the dorsal region, from the Neocomian formations at Kursk, measures 4 inches in length and 5 inches 4 lines in breadth; the terminal articular surfaces are flat; between them the lower surface of the centrum is straight, but at the sides it is gently concave; there are two venous foramina, 2 lines apart, at the middle of the under surface of the centrum.

Portions of ribs from the Upper Green-sand of Cambridgeshire agree in texture, and correspond in proportional size, with the cervical and dorsal vertebral bodies with which they were associated. I have selected one of these fragments for representation in Tab. V, fig. 3, because it shows a well-marked ridge (*s*) on one side, a character I have not seen in the ribs of true *Plesiosauri;* and these portions of ribs, of probably *Polyptychodon,* present a less rounded transverse section.

Atlas and Axis (Tab. VI).

The centrums of the first and second cervical vertebræ coalesced, as in *Plesiosaurus*, from the same locality and formation as the hinder cervical vertebra, Tab. V, present the proportions, in regard to their antero-posterior diameter, of the cervical vertebræ of *Pliosaurus;* but they belong, in all probability, to the same Plesiosauroid reptile as the vertebræ previously described, and I refer them to the genus *Polyptychodon*.

Like most of the fossils from the Haslingfield locality, they have been subject to attrition. The contour of the centrum of the atlas (fig. 1) has been subcircular; its anterior articular surface (*c, a,*) is concave, and has afforded a large proportion of the bottom or middle part of the cup for the occipital condyle. The lower part of the cup has been completed, as in *Plesiosaurus*, by a wedge-shaped hypapophysis, the articular surface for which is shown at *h, y*; the upper contour has been contributed by the neurapophyses, the articular surfaces for which may be discerned at *n, p,* on each side of the smooth neural tract *n*, in figs. 2 and 3.

The line of the original separation of the bodies of the atlas and axis may be traced; the second hypapophysis, or part of it, remains anchylosed to their inferior interspace; it has been much smaller than the first. The posterior surface of the centrum of the axis vertebra (fig. 2, *c, x*) is almost flat, showing the Plesiosauroid nature of the bones. In the similarly short vertebræ of an Ichthyosaurus, this surface would have been deeply concave.

Having thus a proof of the plesiosauroid nature of these anchylosed vertebræ, the same grounds for referring them to *Polyptychodon* apply, as to the posterior cervical vertebra (Tab. V, figs. 1 and 2) of more ordinary plesiosaurian proportions. Between that vertebræ and the axis I infer, therefore, that the anterior cervicals rapidly diminished in length, and that the anterior ones exhibited the same Ichthyosaurian shortness as they do in *Pliosaurus*. The magnitude of the head, jaws, and teeth, of *Polyptychodon* resembled that of its more ancient congener from the Kimmeridge Clay, and the supporting part of the spinal column appears to have been shortened and strengthened accordingly.

It is probable that the large Plesiosauroid paddle, from the Chalk of Kent, the phalanges of which are figured in the 'Monograph on the Fossil Reptilia of the Cretaceous Formations,' for 1851 (Palæont. Soc.), pl. 17, belonged to *Polyptychodon*. Thus the evidence at present obtained respecting the huge but hitherto problematical carnivorous Saurian of the Cretaceous period proves it to have been a marine one—the rival and contemporary of the equally huge Maestricht lizard. But whilst *Mosasaurus*, by its vertebral, palatal, and dental characters, oreshadows the saurian type to follow, *Polyptychodon* adheres more closely

to the prevailing type of the sea-lizards of the great geological epoch then drawing to its close.

The seas in which the English Chalk hills and cliffs were formed, and by which they were modified in the course of upheaval, must have teemed with life, and have been traversed by shoals of fishes needed for the sustentation of the numerous kinds of large marine reptiles now known to have existed during that period, and all of which were provided with jaws and teeth adapted, under diverse secondary modifications, to the capture and destruction of the finny races. Of these carnivorous reptiles some, as, *e. g.*, *Ichthyosaurus campylodon* and *Plesiosaurus Bernardi*, were large species of genera represented throughout the oolitic period; others, as, *e. g.*, *Leiodon* and *Mosasaurus*, offer generic or family modifications of the Saurian structure, unknown in any other than the Cretaceous deposits. The subject of the present section, as gigantic as the Maestricht *Mosasaur*, manifests an extreme modification of the Plesiosauroid type of structure. It is probable that the large Pterodactyles of the same geological period, soaring like albatrosses and giant petrels over the Cretaceous seas, co-operated with the marine reptiles, as those sea birds now do with cetaceous mammals, in reducing the excessive numbers of the teeming tribes of fishes, and in maintaining the balance of oceanic life.

SUPPLEMENT (N°. II)

TO THE

MONOGRAPH

ON THE

IGUANODON.

Dentition of the Upper and Lower Jaws (Tab. VII).

In the year 1858 a considerable part of the skeleton of an Iguanodon was discovered in the Lower Green-sand formation at Black Gang Chine, Isle of Wight. The workmen disposed of various parts of it, as opportunities offered; and before steps could be taken to secure the whole for the British Museum, portions of jaws and teeth had passed into the hands of private collectors. From the best account of the discovery that I could collect, it appeared that the entire cranium, somewhat dislocated, had been brought to light by the quarrymen; but the bones were in a peculiarly fragile, crumbly state, and only the firmer parts of the jaws, lodging the teeth, were secured, and these portions in fragments. Some of them, of both upper and lower jaws, are now in the British Museum; and learning that other portions had been acquired by George Robbins, Esq., F.G.S., of Castle, near Bath, I addressed a letter to that gentleman, who very kindly brought his specimens to London, and liberally placed them in my hands for description.

The largest fragment fitted on to another portion of the jaw in the British Museum, adding to its value as an illustration of the most interesting of the hard parts of the Iguanodon. It consisted of a fragment of the left upper jaw, with three teeth; there were also three fragments of the left ramus of the lower jaw, with one or more teeth in each.

The germs of the new teeth are developed, in all Saurians, as is well known, on the inner or mesial side of the base of the old teeth.* One of the teeth in the portion of the upper jaw (Tab. VII, figs. 1, 2, and 3, *m*) has its summit obliquely

* Of this character Professor Melville ably availed himself in determining the upper and lower teeth of the Iguanodon, in the joint memoir, by Dr. Mantell and himself, in the 'Philosophical Transactions,' for 1848.

worn from above downward and outward to the enamelled trenchant border; the contiguous tooth, *n*, the summit of which has not suffered abrasion, is pressing upon the smooth concave side of the older tooth; a third tooth, *o*, the crown of which is still buried in the alveolus, has the same relation to the more advanced tooth, *n*. The smooth, concave sides of these teeth, shown in fig. 1, are, therefore, the inner or mesial ones, and the flat surface of bone extending from the alveolar border is the inner or palatal alveolar wall of the maxillary bone.

The crown of each tooth shows that more definite and prominent primary ridge on their outer side (*a*, figs. 2, 3, and 4) which is characteristic of the teeth of the upper jaw of the Iguanodon.

In figs. 5 and 6, three of the teeth (*m*, *n*, *o*) show precisely the same stages of growth as the foregoing; one (*m*) has the summit abraded from the enamelled trenchant border downward and outward; in a second (*n*) the crown is extricated, but not worn; in a third (*o*) the major part of the crown is still in the formative cell. The relative position of these three teeth to each other is, in one respect, the reverse of those in fig. 1. The convex ridged side of the crown of the second tooth (fig. 5, *n*,) partly overlaps (instead of being overlapped by) that of the first (*m*), and it is similarly overlapped by the germ of the third (*o*). The side of the jaw to which the newer teeth (*a r*, fig. 5) are nearest is the inner one; the smooth, longitudinally concave, side of the tooth is next the outer side of the jaw (fig. 6); they belong to the lower jaw, and they show the formal characters of mandibular teeth; the primary ridge, *a*, is less produced.

The upper teeth (figs. 1—4) are narrower, in the direction of the length of the jaw, or from *c* to *d*, and are less curved than the lower; the fang and base of the crown are thicker, transversely to the jaw, or from *a* to *g* (fig. 4). The primary ridge, *a*, is more prominent; the secondary ridges, *b*, are less constant and less marked than in the lower teeth. Both fore (*c*) and hind (*d*) borders at the base of the crown are entire, and are bent or produced slightly outward, bounding the transversely concave areæ between them and the primary ridge; they slightly diverge as the crown expands; along its apical half both borders are serrate or serro-lamellate, converge, and, with a slight difference of contour, meet at the apex of the unworn crown formed by the termination of the primary ridge (*n o*, fig. 2). This ridge, *a*, commencing in a tooth $3\frac{1}{2}$ inches long about 1 inch 8 lines from the base, becomes thinner and sharper as it projects, which is to the greatest degree before it reaches the middle of the crown, whence it gradually subsides to the apex; its longitudinal profile is a slight curve convex outward: this ridge divides the outer side of the crown unequally, the front area, *a*, *c*, being broader, sometimes nearly twice the extent of the hind one, *a*, *d*. The dentated margin of the crown to which the primary ridge is the nearest is posterior one, and is the shortest and straightest (fig. 2, *d*). A few, irregular, linear, minute ridges mark the enamel in both areæ; being more numerous, from three to five, in the

wider one, and not more than one or two of these extend from the base to the apex of the crown; at the base they converge and sometimes unite as they descend.

The fore part of the tooth is slightly hollowed at the basal half of the crown (fig. 4, *e*); the fossa, which is elongated and concave transversely, gradually filling up towards the apex; below the middle of the crown, at the apical half, the fore part of the crown (fig. 1, *e*) is convex transversely. The hind part of the tooth (fig. 4, *f*) is impressed by a longer, wider, and shallower depression, beyond which it shows an oblique, rather flattened than convex, surface. The inner part of the tooth, which is narrow in the fang (fig. 4, *g*), gradually expands upon the crown to near the apex, where it again grows narrower; at its broadest part it is flattened or even a little concave transversely, but rounds off convexly into the fore and hind parts of the crown (fig. 1, *m*).

The abraded surface of the crown is remarkably smooth and level; it inclines from before downward and backward, and more so from within downward and outward in the upper jaw.

The longitudinally convex and ridged part of the crown being external in the upper teeth, and the position of the primary ridge determining the fore and hind borders of the crown, a detached tooth may be at once referred to the right or left maxillary bone.

The germ of the successional tooth causes an excavation on the inner, and generally towards the hinder, part of the base of the one in use.

In a left upper tooth, with one fourth of the crown abraded, and projecting 1 inch 9 lines from the alveolar border, the crown of the successional tooth had its apex on a level with that border, and on the inner and back part of this crown was the thin shell of the apex of a third tooth in the successive series.

The outer alveolar wall of the upper jaw is very thin at the outlet of the sockets, and is a little produced at the intervals of the teeth; it rapidly increases in thickness towards the base of the sockets.

The inner or palatal wall also thins off to a crenate edge; so much as is preserved in the specimens examined was flat and smooth, as in fig. 1. The grinding surface of the tooth (*m*), of which one third of the apex had been worn away by mastication, projected only about half an inch from the inner alveolar margin.

The lower or mandibular teeth of Iguanodon have a broader crown, and a fang less thick transversely to the jaw than the upper teeth; they are more curved lengthwise, the curvature being concave outward, contrary to that of the upper teeth. The outer side of the tooth (fig. 6, *m*, and fig. 11, *o*) is smooth and convex from the fore (*c*) to the hind (*d*) border, its greatest breadth being opposite the middle of the crown. The primary ridge, commencing at the enamelled base of the inner and flatter part of the crown (fig. 5, *m*, *a*, and fig. 11, *a*), slowly rises, and is most marked along the apical half, but is here much less prominent than in the

upper teeth; it divides the crown into two unequal areæ, the front one (fig. 5, *m, a, c*) being at its broadest part nearly twice the breadth of the back one (ib., *a, d*). The front area is pretty equally subdivided by a low, secondary, longitudinal ridge, *b*, each division being feebly concave across. The angle between the entire (fig. 11, *i*) and serrated (fig. 11, *c*) parts of the borders of the crown is more marked than in the upper teeth; the basal part of the posterior border (fig. 11, *d*) seems as if it were pushed inward and forward by the crown of the succeeding and less developed tooth. The anterior serrated border (fig. 5, *n, c*), is at first straight, then describes a bold, convex curve as it approaches the apex. The posterior border, (ib., *d*), passes almost to that apex in a straight line before it is rounded off to the obtuse summit, where the primary ridge terminates. At the fore part of the tooth (fig. 9) the fang is convex, and the basal half of the crown shows a lanceolate depression, slightly concave across. The back part of the tooth (fig. 8) shows a longer, shallow depression, *s*, extending over the upper half of the fang and lower third of the crown. The inner or longitudinally convex side of the narrow fang, in worn teeth, is sharply excavated, even to expose the pulp-cavity, by the crown of the successional tooth (figs. 13 and 14, *p*).

The apex of the crown of a young successional tooth is shown, at *r*, on the inner side of the tooth *p* in fig. 5. The remnant of the fang and alveolar depressions of the old and shed teeth are shown at *t, t*, on the outer side of the succeeding teeth, in fig. 7. Both are from the lower jaw.

The upper part of the outer alveolar wall of the mandible bends out, so as to be concave vertically; its border is more deeply crenate than in the upper jaw. A vascular canal runs about an inch and a half beneath it, from which the oblique orifices open upon the outer surface of the mandible.

Figs. 10 to 14, in Tab. VII, from the dental series of the same individual, discovered in the Green-sand of Black Gang Chine, exemplify different degrees of destruction of the tooth by abrasion and absorption. Fig. 10 is an unworn tooth from the fore part of the lower jaw. Figs. 11 to 14 show the size of the majority of the teeth. In figs. 13 and 14 the letter *p* marks the cavity caused by pressure of the new or successional tooth; in fig. 14 it has laid open the pulp-cavity of the old tooth.

Fig. 15 shows the inner side, and fig. 16 the fore part, of a mandibular tooth of a young Iguanodon, from the Upper Green-sand near Cambridge. The inner side of the fang shows the excavation due to the pressure of the successional tooth (*p* fig. 15). Fig. 17 shows the outer and inner sides of a smaller tooth of an Iguanodon, from the same formation and locality. All the evidences of Iguanodon which have yet reached me therefrom indicate a small size; but whether this may relate to the immaturity of the individual, or to a small variety, I am uncertain.

MONOGRAPH

ON THE

FOSSIL LACERTIAN REPTILES

OF THE

PURBECK LIMESTONES.

ORDER—*LACERTILIA*.

Genus—NUTHETES,* *Owen*.

NUTHETES DESTRUCTOR, *Owen*.

FOR a knowledge of the fossil remains on which the present genus and species were founded,† I am indebted to Charles Wilcox, Esq., M.R.C.S., of Swanage, Dorsetshire, by whom the specimens submitted to me, including a portion of jaw with teeth, were discovered in the Purbeck formation, from the bed marked *k* 93 in Mr. Austen's 'Guide.'‡

The teeth are attached by partial anchylosis to depressions on the inner side of an alveolar wall, or according to the "pleurodont type." Their enamelled crowns are moderately long, compressed, pointed, slightly recurved, with a well-marked but finely serrated margin before and behind; the thickest part of the crown is not at the middle, but nearer the anterior border, as in the great Varanus (*Var. crocodilinus*) and in *Megalosaurus*; and they clearly resemble, in

* Abbreviated from *νουθέτηης*, *Monitor*; in reference to the resemblance of the teeth of the fossil to those of the modern Varanian Monitors.

† 'Quarterly Journal of the Geological Society,' 1854, p. 120.

‡ 'Guide to the Geology of the Isle of Purbeck,' by the Rev. J. Austen, M.A., Blandford, 1852.

miniature, the teeth of that great carnivorous reptile. To the question whether these Purbeck fossils might not be of a fœtus or young of Megalosaurus, the answer is, that the lower jaw of the Nuthetes differs from that of Megalosaurus in not having the inner alveolar wall developed in the same degree, and in not exhibiting any rudiments of alveolar divisions.* The inner wall is not produced in a greater degree than in the modern *Varani*. The largest teeth measure two lines in diameter at the base of the crown, which is more or less excavated on the inner side by the pressure of the matrix of a successional tooth.

The length of the largest fragment of the mandible was one inch and a half; the depth of the outer wall was six lines, that of the inner wall was from three to four lines. The exterior surface of the bone is smooth and polished, but shows under the pocket lens very fine longitudinal linear markings; it is perforated by a series of nervo-vascular foramina along the alveolar wall, and is traversed near the lower margin by a line answering to the suture dividing the dentary from the angular piece in the jaw of *Varanus*.

The fossils give evidence of a carnivorous or insectivorous lizard of the size of *Varanus crocodilinus*, or great land monitor of India. The specific name relates to the adaptations of the teeth for piercing, cutting, and lacerating the prey.

Of the vertebral characters I have not, as yet, received satisfactory evidence. *Nuthetes destructor* is referred solely on mandibular and dental characters to the "pleurodent section" of the order Lacertilia. But, in the same division of the Purbeck strata, viz., from the "Feather Quarry," containing *Cyclas* and *Planorbis*, have been found long bones of a small Saurian and dermal scutes, agreeing, in regard to proportional size, with the jaw and teeth of *Nuthetes*. The bones present the characters of tibia and fibula, and are longer in proportion to their breadth than in any known recent form of Crocodilian; they are associated in the same slab with the scutes, which are subquadrate in form, about eight lines in one diameter and six lines in the opposite; smooth on the inside, impressed by minute, circular pits on the outside, and presenting more the character of the bony, dermal scutes of *Crocodilia* than of those of any known species of *Lacertilia* so defended. Additional evidence is needed to determine the relations of these small, pitted, dermal scutes to the bones and teeth of *Nuthetes*.

* 'Monograph on Megalosaurus, vol. for 1856, p. 21.

Genus—Saurillus,* *Owen.*

Saurillus obtusus, *Owen.*

The fossils upon which the above genus and species were founded† were transmitted for my determination, in 1854, by Mr. W. R. Brodie, of Swanage, and were discovered by that persevering explorer of the Purbeck beds, in the "Dirt-bed" (No. 93) of Mr. Austen's 'Stratigraphical List' above cited.

The most instructive specimen consisted of the right dentary element of the lower jaw, containing thirteen teeth. These are moderately long, conical, and obtuse; but are neither so long nor so recurved as in *Nuthetes*, nor are the crowns compressed, as in that genus. On the outer side of the dentary bone, not far below the alveolar border, are six nervo-vascular foramina in a longitudinal row, relatively as numerous and large as in Iguanodon, and indicating, as in that and other Saurian reptiles, the scaly covering of the jaws and the equally reptilian simple and subdivided condition of the salivary apparatus in *Saurillus*. The teeth are implanted according to the pleurodont type.

Supposing the fossil to have come from a mature individual, the size of the animal must have been nearly that of the common European lizard, *Lacerta agilis*. It was most probably insectivorous. The specific name, "*obtusus*," refers to the obtuse termination of the muzzle, as indicated by the form of the fore part of the jaw, and also to the blunt apices of the conical teeth.

Genus—Macellodon,‡ *Owen.*

Macellodon Brodiei, *Owen.* Tab. VIII, fig. 10.

In the slab of the fresh-water Purbeck stone containing the portions of upper and lower jaw, with teeth, on which the above genus and species were founded,§ there were also specimens of small, subquadrate, pitted, dermal scutes, and of a vertebral neural arch, corresponding proportionally in size with the teeth.

One specimen consists of the right superior maxillary bone, containing eight

* Abbreviation of σαυρος, *saurus*, a lizard.

† 'Quarterly Journal of the Geological Society,' No. 40, pp. 423 and 482.

‡ Μακελλα, *a spade*, ὀδους, a tooth.

§ 'Quarterly Journal of the Geological Society,' 1854, p. 422.

nearly entire teeth, and showing the places of attachment of thirteen or fourteen such teeth, the mode of attachment being by partial anchylosis to the bottom of an alveolar groove and to the side of an outer alveolar wall.

The crown of the teeth is broad, compressed, with sharp, subcrenate margins at the apical half, curving in most to a low point at the summit, and having a semicircular contour when this is worn away, as at *c*, fig. 10. A few of the anterior teeth are narrower, and the crenate margins converge, almost straight, to a sharper point, as in *a*, fig. 10. The older teeth have the crown reduced by attrition to the shape of a spade (*b*, fig. 10), suggesting the name of the genus. The enamel is marked by very fine, longitudinal ridges, the terminations of which give the crenate character to the unworn margins of the crown; a larger longitudinal rising marks the middle of the flattened surface, and is more conspicuous on the outer than the inner side of the crown in the lower jaw; it commences at a short distance from the base of the enamelled crown, and terminates at the apex. From this middle, thickest part of the crown the tooth narrows to the lateral margins, its transverse section across the middle of the crown resembling that of the upper part of the crown of the tooth of *Echinodon* (fig. 6, *b*).

In a portion of the upper maxillary bone of *Macellodon Brodiei*, the low palatal alveolar plate terminates internally in a smooth border, which had formed the outer boundary of an extended palatal vacuity, as in most lizards; this structure, with the unequal development, the succession, and pleurodont mode of implantation of the teeth, indicates the Lacertian affinities of *Macellodon*.

In a small slab from the lower part of the Purbeck stratum, called "dirt-bed, containing shells," Mr. Brodie discovered the dentary element of the lower jaw of *Macellodon*, containing thirteen teeth, and alveolar depressions for twenty; with this were associated the neural arch of a vertebra, portions of ribs, and some dermal, bony scutes. The teeth in place were anchylosed to depressions in an outer alveolar wall; a few at the fore part of the jaw were less expanded relatively to their length than the rest, which presented the Macellodont type of crown. They are separated by slight intervals, and the teeth are much smaller in proportion to the jaw than in *Nuthetes*. The dentary bone, figured of the natural size at Tab. VIII, fig. 10, presented the posterior notch for articulation with the angular and surangular elements; its outer surface is convex, and perforated at its anterior half by a linear series of nervo-vascular canals.

The neural arch associated with the above portion of lower jaw bears a greater proportional size thereto than in most lizards; it exhibits long diapophyses, as in the lumbar and anterior caudal Saurian vertebræ, supports a moderately long spine, and shows a small, circular, neural canal; the zygapophyses have been broken away from the exposed surface; and the centrum has been, apparently, detached from a sutural connexion with the arch, which would be rather a crocodilian than a Lacertian character.

The dermal scutes agree in proportional size with the vertebra; they are subquadrate, smooth, and slightly concave on the inner surface; they are impressed with small, round pits on the outer surface; of two scutes in apparently natural juxtaposition, one slightly overlapped the other.

The length of the dentary bone of *Macellodon*, above described, is 9 lines, or 17 millimètres; the breadth of the neural arch across, and including the diapophyses, is 10 lines; the long diameter of a scute is 9 lines; its short diameter, 6 lines. On the supposition, raised by the collocation in the same slab of these remains, that they may have been parts of the same animal, we should reconstruct, in idea, a Lacertian with a proportionally small and short-jawed head, and with a skin defended by crocodilian scutes; but I have seen similar scutes accidentally associated, in another block of Purbeck clay, with mammalian jaws and teeth, and they may have no closer relation to *Macellodon*.

The remains of small, lizard-like reptiles, with teeth more or less fitted for piercing, cutting, or crushing the chitinous coverings of *Articulata*, are such as might be expected in the marly shell-beds of the Purbeck series, which have afforded such abundant evidence of insect life;* and with them are associated remains of small, insectivorous mammals.† The numerous remains of plants in the same formation, some referable to *Cycas*, others to *Zamia*, illustrate also the interdependency between the insect class and the vegetable kingdom. Amongst the numerous and various Entomophaga organized to pursue and secure the countless and diversified members of *Insecta*, in the air, in the waters, on the earth, and beneath its surface, bats, lizards, shrews, and moles now carry on simultaneously their petty warfare, and in warmer climates in the same localities. In like manner, we now have evidence that lizards and mammals co-operated in the same locality, at the same task of restraining the undue increase of insect life during the deposition of the lower Purbeck beds.

Genus—Echinodon,‡ *Owen*.

Echinodon Becclesii, *Owen*. Tab. VIII, figs. 1—9.

The specimens figured in the above-cited plate were discovered by S. H. Beccles, Esq., F.R.S., in the thin, fresh-water stratum, containing shells§ and

* See the Paper by Mr. Westwood, in the 'Quarterly Journal of the Geological Society,' 1854, p. 378.

† See my Paper on *Spalacotherium*, ib., p. 426.

‡ 'Εχῖνος, *hedgehog*, and ὀδους, *tooth*, "prickly tooth."

§ Species of *Valvata*, *Limneus*, *Cypris*, and *Physa*, apparently *Physa Bristovii*.

vegetable remains, high up the cliff, at Durdleston Bay, Isle of Purbeck. They consist of portions of the upper and lower jaws of a Saurian, allied, by the shape of the teeth, to *Macellodon*, but of much larger size, and with the thecodont implantation of the teeth. The crown belongs, in general shape, to that lamelliform, leaf- or scale-shaped type, of which the teeth of *Palæosaurus*, *Cardiodon*, *Hylæosaurus*, *Macellodon*, and even those of *Iguanodon*, are modifications. The teeth of the present genus are distinguished by the marginal serrations of the apical half of the crown, which increase in size from the apex to the base of that angular part of the tooth, the two basal points resembling spines, and terminating respectively, or forming the confluence of, the two thickened ridges (*r*, fig. 2, *c*) bounding the fore and hind borders of the basal half of the crown.

The crown is supported on a subcylindrical fang, and suddenly expands, both transversely (Tab. VIII, fig. 2, *c*) and antero-posteriorly (ib., *b*). In the former direction it as quickly begins to contract, and the outer and inner sides converge in almost a straight line to the apex; in the latter direction the crown continues expanding for about half, or rather more, of its longitudinal extent, with a slightly convex contour; it then rapidly contracts to the apex, the converging borders meeting at a right or somewhat acute angle, and being serrated as above described. The thickest mid-part of the crown forms a longitudinal rising, usually more marked on one side of the tooth; at the apical half the crown gradually becomes thinner towards the fore and hind margins; but at the basal half these margins are thickened, and cause the surface between them and the mid-rising to be undulated transversely. At the apical part of the tooth both the outer and inner sides are gently convex, the transverse section giving the thin-pointed ellipse, as in fig. 6, *b*.

The outer and inner enamelled sides of the crown each describe a curve at their base (fig. 3, *b*, *r*), convex towards the fang; these bases are somewhat thickened and rounded, so as to project from the fang; they converge at the fore and hind parts of the tooth, and unite at an acute angle (fig. 2, *c*, *r*), to form the long, basal points (fig. 3, *b*, *s*) of the serrated half of the crown. The foregoing characters apply to the majority of the teeth of *Echinodon*.

A portion of the left superior maxillary bone, imbedded in the matrix, with its outer surface exposed, is represented in Tab. VIII, fig. 1, and in outline, of the natural size, at *a*. The anterior, probably premaxillary, part has been detached and broken. Three teeth, more or less fractured, project from sockets in the alveolar border of this part; their crowns are less expanded than in the typical maxillary and mandibular teeth. Part of the boundary of an external nostril is indicated at *n*., the larger maxillary fragment the first two teeth present a similar form, and the entire crown of the second shows it to be longer, as well as more slender, than the posterior teeth; it resembles a canine tooth in both shape and position, the crown

being subcompressed and slightly recurved, as well as sharp-pointed. It would serve well to pierce and retain a living prey.

The tooth succeeding the laniariform one presents the typical characters; beyond it the jaw-bone has been broken away in splitting the matrix, and the detached part adheres to the opposite layer (fig. 2). In fig. 1 are shown the impressions of four of the teeth preserved in the slab (fig. 2). Above the first impression (*o*, fig. 1) is the crown of a successional tooth, about to displace the tooth (*o*, in fig. 2). The outer side of a type upper maxillary tooth is shown, magnified at fig. 1, *b*.

The remainder of the upper maxillary, with part of the palatine and pterygoid bones of the left side, are represented adhering to the other half of the split slab in fig. 2, and of the natural size, in outline, at *a*. The extent of the inner alveolar wall, effecting, with the cross partitions, the lodgement of the teeth in sockets, is here demonstrated. The expanded crowns of the teeth come into contact. The inner surface of the crown is shown at *b*, in which the middle longitudinal rising is rather less prominent than on the opposite surface. The fore part of the crown is represented at *c*, showing the angle at which the obtuse basal borders of the enamelled crown meet there; the cement covering the fang is continued upon the crown within that angle.

The outer side of a portion of the right superior maxillary bone, with eight contiguous molars, is represented in fig. 3, and of the natural size, in outline, at *a*. There is a linear row of small foramina above the alveolar border. The median longitudinal rising of the crown of the teeth is more strongly marked on this, the outer, surface, as shown in the tooth magnified at *b*, fig. 3.

In fig. 4 is represented the inner surface of the posterior part of a right, superior maxillary bone, containing six contiguous teeth, with a less prominent or less defined median rising of the teeth in this fragment; the last three teeth gradually decrease in size. There is no discernible trace of the socket of another tooth beyond the sixth (*x*). A portion of the bony palate remains, which gives evidence of a large palatal vacuity, probably internal nostril, at *u*, and of a posterior palatal vacuity at *v*, probably corresponding with those in the Iguana.

The inner surface of a portion of a ramus of the mandible, with eight contiguous teeth, is represented at fig. 5, and in outline, of the natural size, at *a*.

The fore part of a right ramus, consisting chiefly of the dentary element, is represented in figs. 6—8, and of the natural size, in outline, at *a*. Fig. 6 gives the outer side, but the whole vertical extent of the bone is only preserved at the symphysial end. The apex of a young tooth projects from the fifth of the sockets here preserved; it is represented magnified at *a* and *b*.

There is a linear series of small, nervo-vascular foramina a little below the alveolar border. The crowns of the developed teeth have been broken away;

their fangs in the sockets are shown in fig. 7; the anterior teeth are narrower than the rest, as in the upper jaw. The crushed or broken state of the specimen at the opposite end prevents a determination of the total number of sockets in this ramus. On the inner side of the specimen (fig. 8), a considerable extent of the symphysis (*s*, *s*) is shown.

The posterior part of a broken and distorted dentary element of the left ramus of the mandible is represented in fig. 9, showing the last eight teeth, and the impressions of the crowns of as many in advance. A portion of the crown, displaced, of the fourth from the last is preserved, and likewise portions also of those in advance, which have been broken in splitting the slab, so that they appear smaller than they actually were. The last three teeth are entire, and show a gradual decrease of size, as in the portion of upper jaw (fig. 4). A magnified view of the inner surface of the last lower tooth is given at *a*, fig. 9.

From the characters of jaws and teeth above described, the extinct animal presenting them might be referred to the modern Lacertian group: but the structure of the vertebræ and limb-bones must be ascertained before the ordinal affinities of *Echinodon* can be satisfactorily determined.

The modifications of the mode of implantation of the teeth in the known limits of the Dinosaurian order affect the value of the thecodont character as a mark of affinity. The dentition of *Echinodon*, in respect to the shape of the crowns of the teeth, appertains to the category embracing *Macellodon*, *Cardiodon*,* *Hylæosaurus*, and *Iguanodon*. From *Macellodon* the present genus differs in the swollen borders of the basal half and the stronger serration of the apical half of the dental crown. The similarly expanded crown of the tooth of *Cardiodon* has thicker and apparently not serrate margins, it is not divided into a basal and apical portion, and the apex is more obtuse. In *Hylæosaurus* the crown of the tooth is thicker and less expanded than in *Echinodon;* the borders of the apical half are usually abraded by masticatory acts, show no marks of serration, and meet at an angle of 80°; but the crowns of the teeth were in contact, as in *Echinodon*. The more complex structure of the teeth of *Iguanodon* appears, nevertheless, to be due to additions superposed upon a type of tooth which is essentially like that of *Echinodon*. The expanded crown is divided into a basal and apical portion; the marginal serrations of the latter are coextended with the increased thickness of the part into small lamellæ, themselves more minutely dentate. The middle longitudinal rising of the enamel, which in *Echinodon* has appeared to me to be stronger on the outer side of the upper teeth and on the inner side of the lower teeth, is exclusively developed, as the "primary ridge" on the corresponding aspects of the teeth of the upper and lower jaws in *Iguanodon*. In the small teeth, or those of the

* From the Mid-Oolitic Formation, called "Forest Marble," near Bradford, Wilts. See my 'Odontography,' p. 291, pl. 75*a*, fig. 7.

young *Iguanodon,* the primary ridge is median and well-marked, and in the unworn tooth forms, or terminates at, the apex of the crown, increasing its resemblance to the echinodont type of tooth. The difference of dental structure between *Echinodon* and *Iguanodon* is of the adaptive kind; relating in the former to animal food, in the latter to a mixed or vegetable diet. The entire dentition of *Echinodon* appears so well fitted to pierce the scaly covering of fishes, and retain the struggling prey, that I suspected the species to have been ichthyophagous, and, like the *Amblyrhynchus* of the Gallopagos Islands,* to have been aquatic in its habits.

My fellow-labourer in palæontology, Dr. Falconer, F.R.S., by whose labours that science has been so much enriched, suggested the name *Sauraechinodon* for the present Purbeck reptile; but as I am not aware that the more abridged form has been preoccupied, I have adopted *Echinodon* as sufficiently distinctive, having reference to the almost spiny character of the larger basal serrations of the apical half of the tooth.

The present species is dedicated to its discoverer, Mr. Beccles, of whose collection of Purbeck fossils the specimens here described form part; and I record with pleasure my grateful sense of the liberality with which they have been confided to me for elucidation.

* Darwin, 'Voyage of the *Beagle*,' vol. iii, p. 466.

TAB. I.

Pterodactylus Simus.

Fig.

1. Fore part of the upper jaw, left side.
2. Ditto, right side.
3. Ditto, front view.
4. Ditto, upper view.
5. Ditto, under view.
6. Hind part of the right ramus of the lower jaw, inner side.
7. Ditto, outer side.
8. Ditto, under side.
9. Ditto, upper side.
10. Ditto, section.
11. Occipital condyle.
12. Basi-occipital, side view.
13. Ditto, upper view.
14. Atlas and axis vertebræ, front view.
15. Ditto, side view.
16. Ditto, back view.

The foregoing figures are of the natural size, and from specimens in the Woodwardian Museum of the University of Cambridge; they were obtained from the Upper Green-sand formation near that town.

Jos Dinkel lith

W West imp

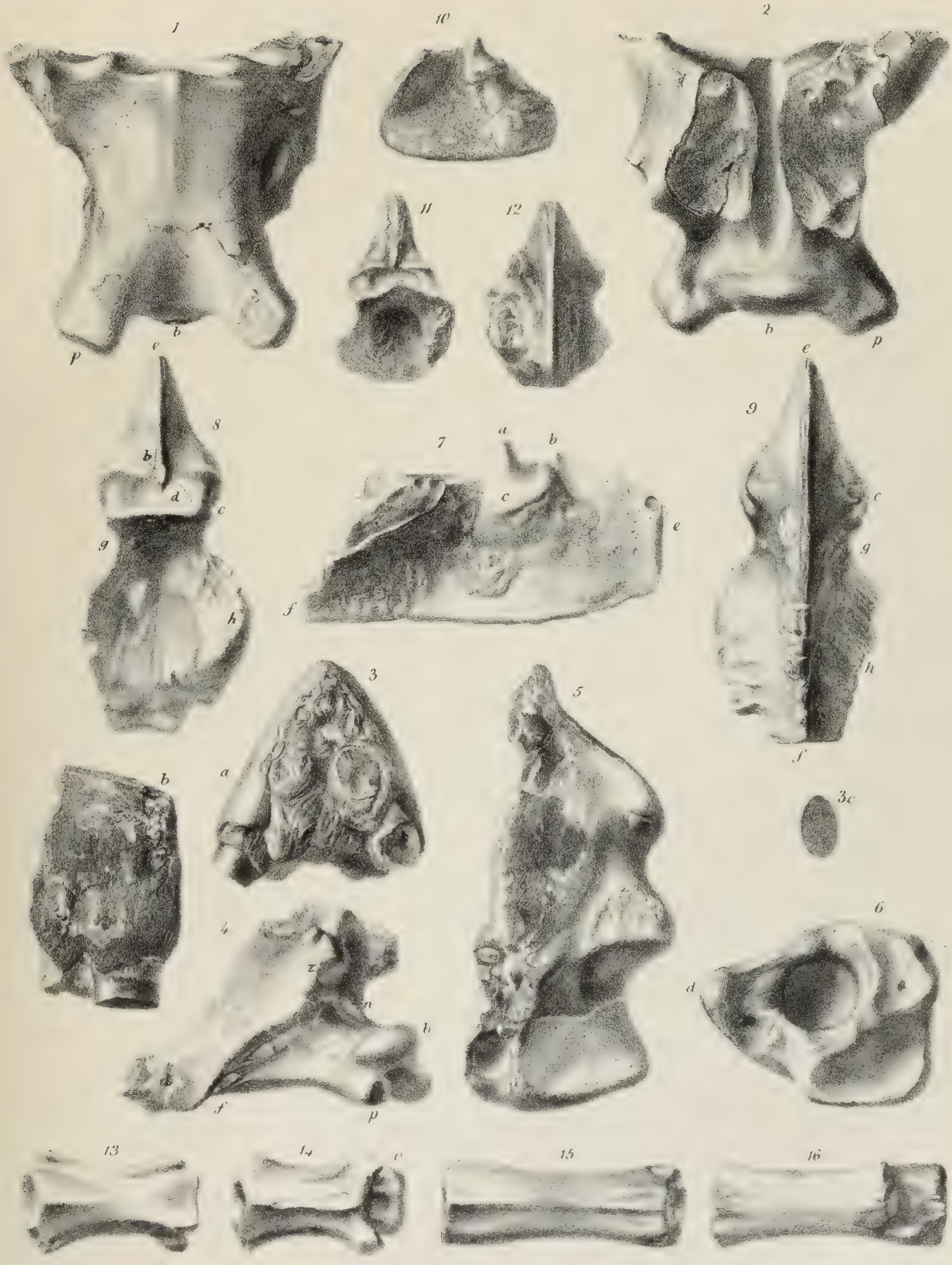
TAB. II.

Pterodactylus Simus and *Pter. Woodwardi.*

Fig.

1. Middle cervical vertebra, under view.
2. Ditto, upper view.
3. *a.* Fragment of jaw, section.
   b. Ditto, side view.
   c. Ditto, section of tooth.
4. Lower cervical vertebra, oblique view.
5. Glenoid articular cavity formed by the anchylosed ends of the scapula and coracoid.
6. Scapho-cuneiform (?) carpal bone.
7. Fore part of sternum, side view.
8. Ditto, upper view.
9. Ditto, under view.
10. Fore part of a smaller sternum, side view.
11. Ditto, upper view.
12. Ditto, under view.
13. Anterior caudal vertebra, under view.
14. Ditto, upper view.
15. Middle caudal vertebra, under view.
16. Ditto, upper view.

All the figures are of the natural size, and from specimens in the Woodwardian Museum of the University of Cambridge ; they were found in the Upper Green-sand formation near that town.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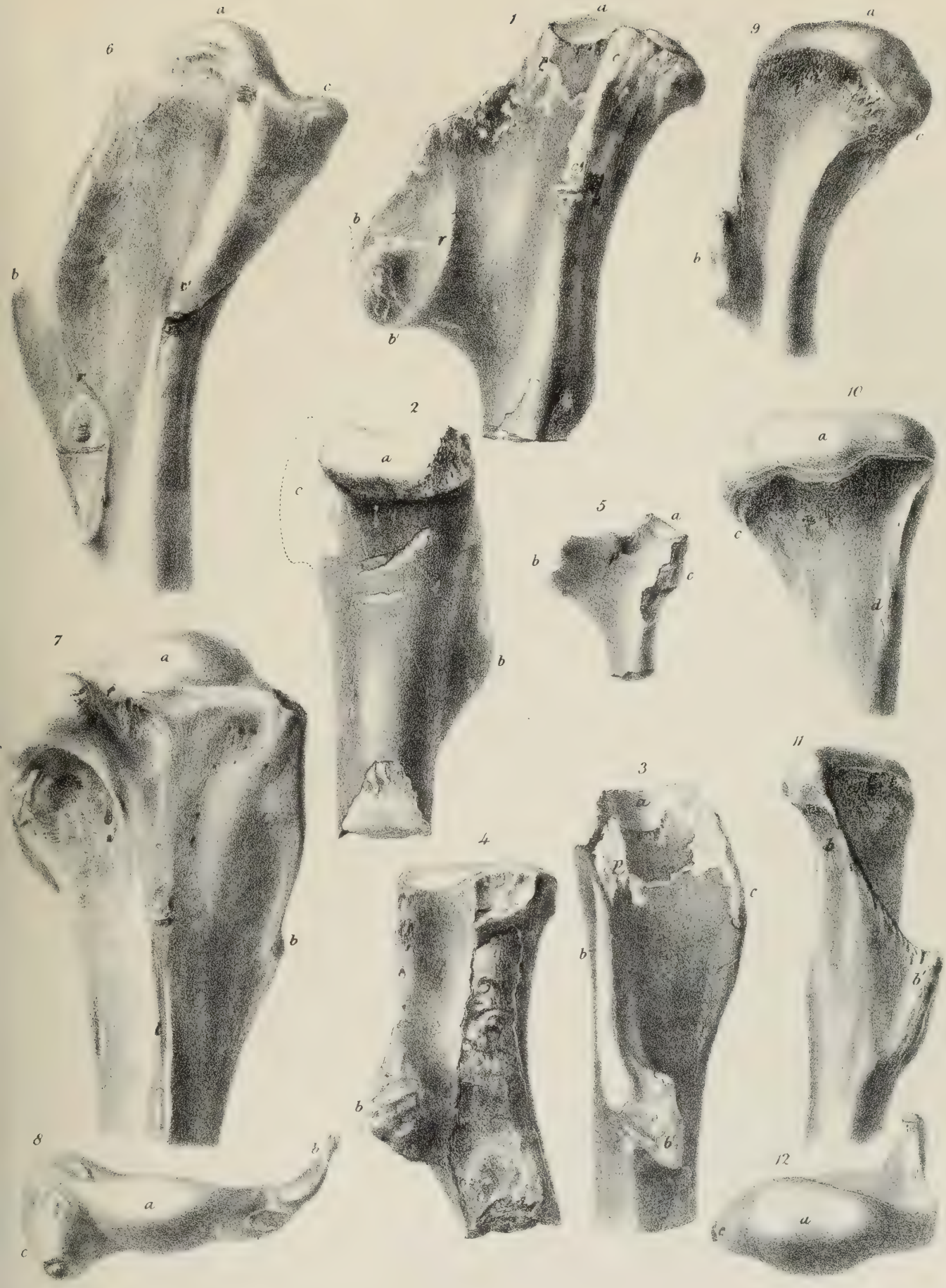
TAB. III.

Humerus of Pterodactyle.

Fig.

1. Proximal or upper end of right humerus, oblique view of palmar and ulnar surfaces.
2. Ditto, anconal surface.
3. Ditto, palmar surface.
4. Proximal end of a left humerus, drawn without reversing, oblique view as in fig. 1.
5. Proximal end of a right humerus of a smaller species of *Pterodactyle*, oblique view as in figs. 1 and 4.
6. Proximal end of the right humerus of a bird (*Vultur monachus*), oblique view of palmar and ulnar surfaces.
7. Ditto, anconal surface.
8. Ditto, upper surface, or head.
9. Proximal end of the right humerus of a crocodile (*Crocodilus biporcatus*), oblique view of palmar and ulnar surfaces.
10. Ditto, anconal surface.
11. Ditto, oblique view of the palmar and radial surfaces.
12. Ditto, upper surface, or head.

All the foregoing figures are of the natural size; 1 and 3, probably of *Pterodactylus Cuvieri*, are from the White Chalk of Kent; 4, probably of *Pter. Sedgwickii*, and fig. 5, are from the Upper Green-sand formation, near Cambridge. The foregoing specimens are in the Woodwardian Museum of the University of Cambridge.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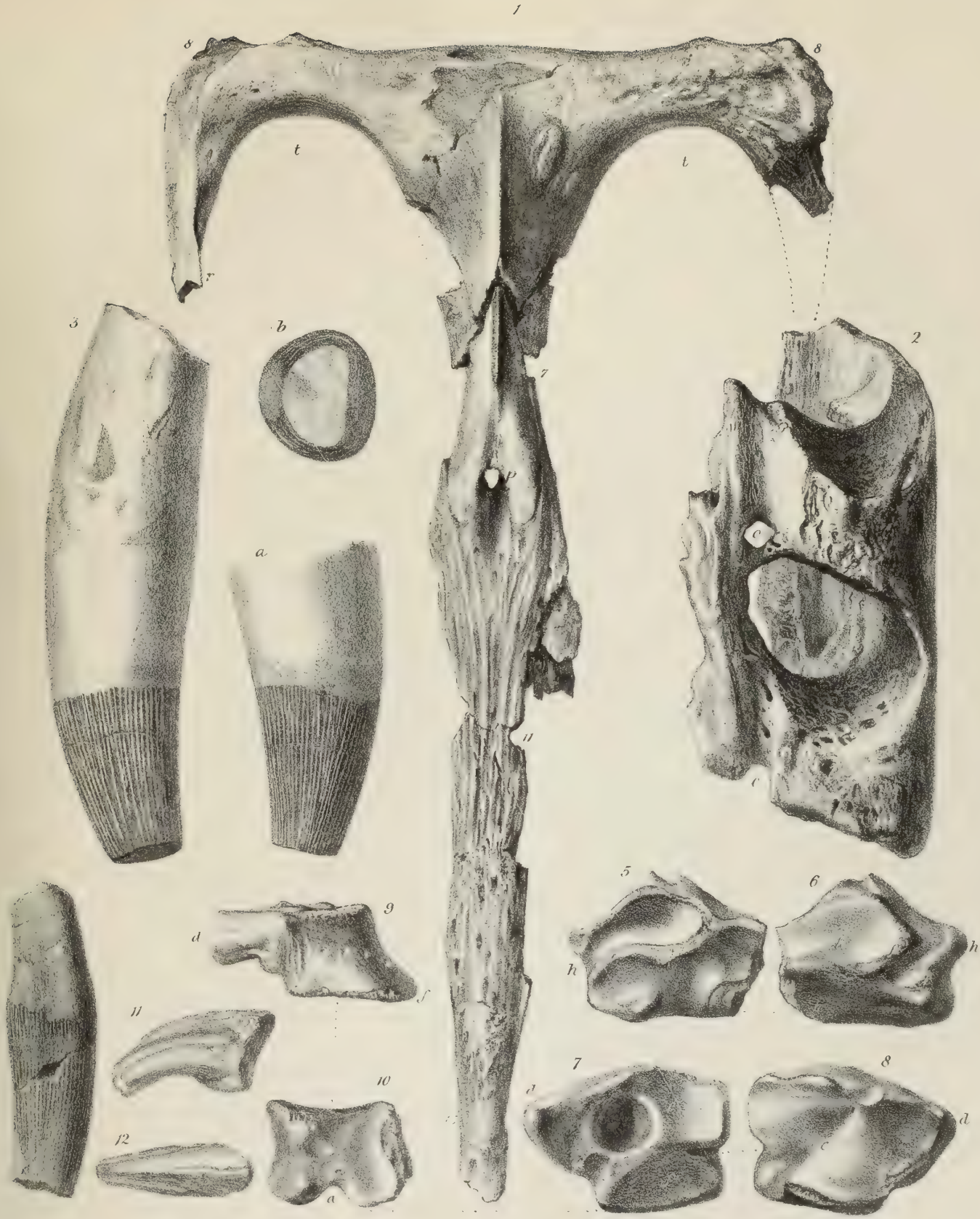
TAB. IV.

Fig.

1. Upper view of a part of the cranium of *Polyptychodon interruptus*; one fourth the nat. size.
2. Fragment of the alveolar part of the same cranium; nat. size.
3. A tooth of the same specimen, side view, nat. size; *a*, ditto, opposite side; *b*, ditto, section of fang, showing pulp-cavity.
4. Basal half of a tooth of *Pterodactylus simus*; nat. size.
5. Unciform? carpal bone of *Pterodactylus Sedgwickii*, proximal? surface.
6. Ditto, distal? surface.
7. Scapho-cuneiform? carpal bone of *Pterodactylus Sedgwickii*, proximal? surface.
8. Ditto, distal? surface.
9. Ditto, side view.
10. Ditto, end view.
11. Ungual phalanx of *Pterodactylus Sedgwickii*, side view.
12. Ditto, upper view.



Jos Dinkel lith

W West imp

TAB. V.

Polyptychodon interruptus.

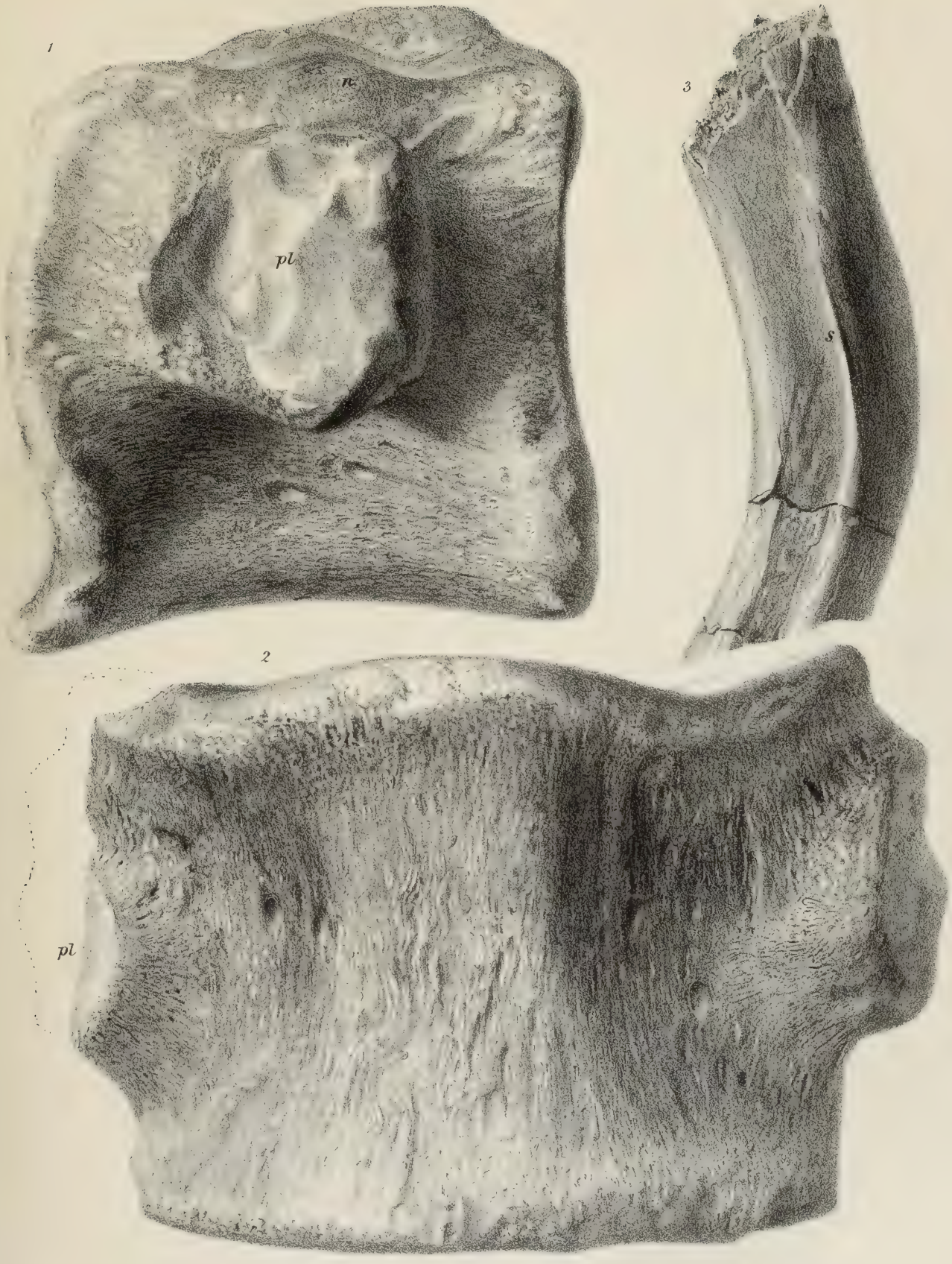
Fig.

1. Centrum of posterior cervical vertebra, side view.

2. Ditto, under view.

3. Fragment of a dorsal rib.

These figures, of the nat. size, are from specimens in the Woodwardian Museum of the University of Cambridge; and are from the Upper Green-sand formation near that town.



Jos Dinkel lith

W West imp

TAB. VI.

Polyptychodon interruptus.

Fig.

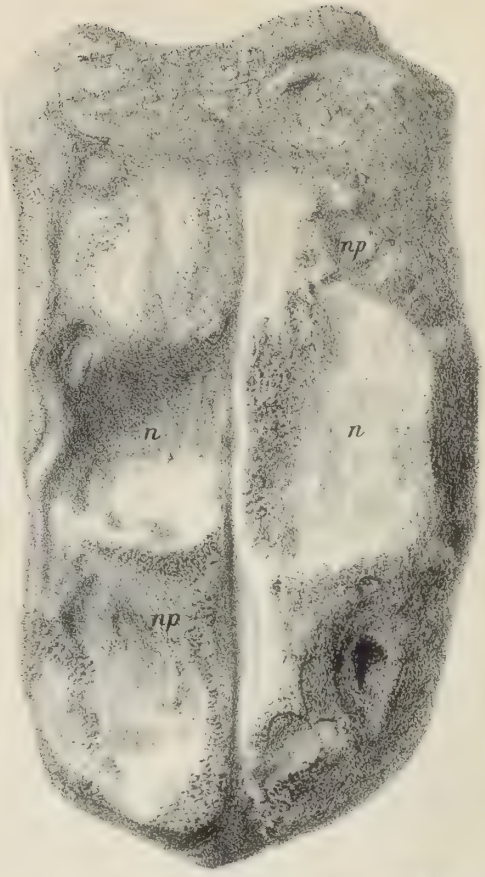
1. Centrum of the atlas vertebra, front view.

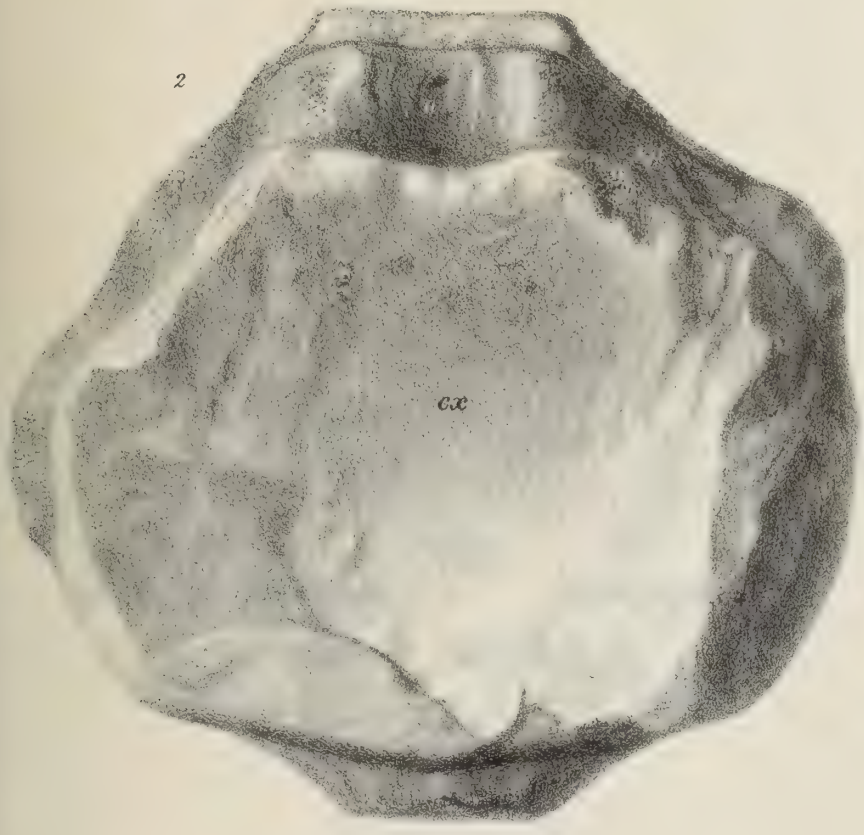
2. Centrum of the axis vertebra, back view.

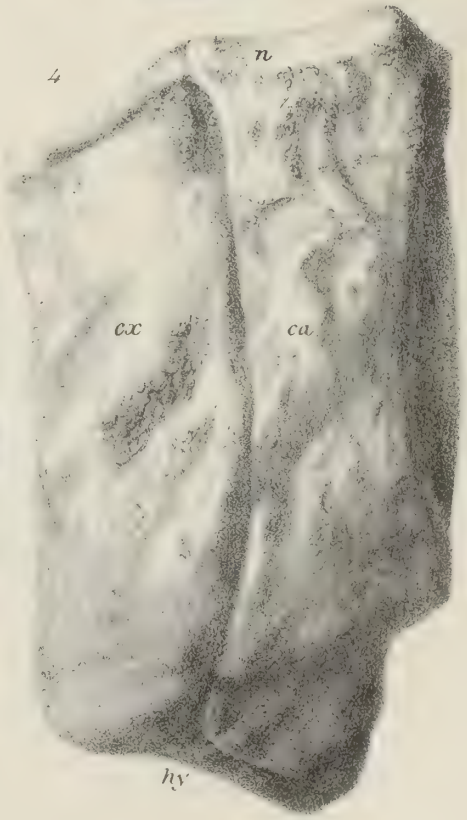
3. Anchylosed centrums of the atlas and axis vertebræ, upper view.

4. Ditto, side view.

These figures, of the nat. size, are from a specimen in the Woodwardian Museum of the University of Cambridge, discovered in the Upper Green-sand formation near that town.







Jos. Dinkel lith.

W. West imp

TAB. VII.

Iguanodon Mantelli.

Fig.

1. Fragment of the left upper jaw, with three teeth, inner side.
2. Ditto, outer side.
3. Ditto, free or working surface of the crowns of the teeth.
4. Fragment of the upper jaw, with two teeth, showing their transverse section.
5. Fragment of the left ramus of the lower jaw, with four teeth, inner side.
6. Ditto, outer side.
7. Ditto, upper view.
8. A lower tooth, back surface.
9. Ditto, front surface.
10. An unworn lower tooth; *i*, inner, *o*, outer surfaces.
11. A lower tooth, slightly worn; *i*, inner, *o*, outer surfaces.
12. A lower tooth, more worn; *i*, inner, *o*, outer surfaces.
13. A lower tooth, more worn; *i*, inner, *o*, outer surfaces.
14. A lower tooth, worn to the fang; *i*, inner, *o*, outer surfaces.

All the foregoing figures are of the natural size, from parts of the same individual Iguanodon, discovered in the Lower Green-sand formation at Blackgang Chine, Isle of Wight. In the British Museum, and in the Collection of George Robbins, Esq., V.G.S., of Bath. Figs. 15, 16, and 17, are from the Upper Green-sand formation near Cambridge.

Jos Dinkel lith

W.West imp

TAB. VIII.

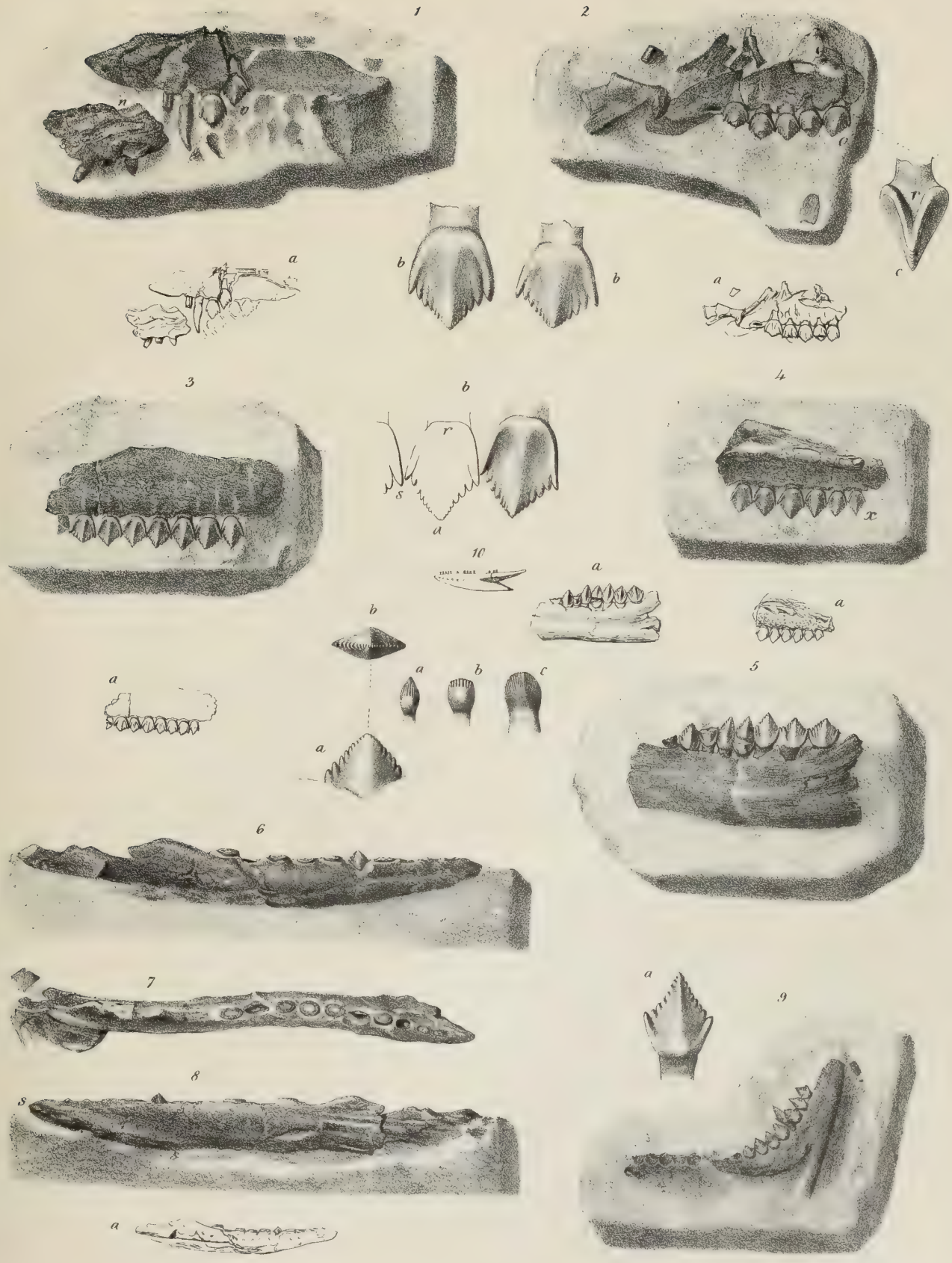
Echinodon Becclesii.

Fig.

1. Portion of the left upper jaw, outer side ; *a*, nat. size, *b*, tooth magnified.
2. Ditto, inner side ; *a*, nat. size, *b*, tooth magnified.
3. Portion of the upper jaw, outer size ; *a*, nat. size, *b*, tooth magnified.
4. Portion of upper jaw, inner side ; *a*, nat. size.
5. Portion of lower jaw, inner side ; *a*, nat. size.
6. Anterior portion of right ramus of lower jaw, outer side.
7. Ditto, upper surface.
8. Ditto, inner side ; *a*, nat. size, *b*, tooth magnified.
9. Portion of the lower jaw, twice nat. size ; *a*, tooth magnified.

   The foregoing figures are from specimens in the Collection of Samuel H. Beccles, Esq., F.R.S., and are from the Fresh-water beds of Purbeck, Dorsetshire.

10. Dentary element of left ramus of lower jaw of *Macellodon Brodiei*, nat. size ; *a*, *b*, *c*, teeth magnified. In the Collection of W. R. Brodie, Esq., of Swanage, from the Fresh-water beds of Purbeck.



Jos. Dunkel lith.

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THE

PALÆONTOGRAPHICAL SOCIETY.

INSTITUTED MDCCCXLVII.

LONDON:

MDCCCLX.

A MONOGRAPH

OF

BRITISH

CARBONIFEROUS BRACHIOPODA.

BY

THOMAS DAVIDSON, F.R.S., F.G.S.,

ETC.

PART V.

THIRD PORTION.

LONDON:

PRINTED FOR THE PALÆONTOGRAPHICAL SOCIETY.

1860.

PRINTED BY J. E. ADLARD, BARTHOLOMEW CLOSE.

Obs. The true character of this species has not always been clearly understood, so that some confusion has resulted from incorrect identifications. Professor Phillips states that his shell is pentahedral, depressed, with the middle of each valve planosulcate; but although some specimens do agree with this description, as well as with the single illustration (fig. 2) published in the 'Geology of Yorkshire,' still the larger number are more or less circular or ovate marginally, with their valves equally deep and evenly convex (figs. 4, 8—10). Professor Phillips was not aware that in the perfect condition his shell was provided with numerous flat concentric plates, which were produced from each successive line of growth, and prolonged, in some specimens, nearly an inch from the surface of the shell (fig. 8), and it is to similar examples that Professor M'Coy applied the generic and specific demonstration of *Actinoconchus paradoxus* in 1844, and *Athyris paradoxa* in 1855.

In 1840 M. de Verneuil published a figure of the same shell, with its marginal expansions, which he had found at Visé, in Belgium, under the name of *Terebratula de Royssii*,[1] from not being then aware of the difference in character of the expansions in Phillips' and L'Eveillé's species.

These appendages in *A. planosulcata* have been described as continuous concentric plates, but those in *A. de Royssii* are in the shape of numerous concentric ridges, from each of which radiate closely-set fringes of elongated, somewhat flattened, spines.

In 1843 Professor de Koninck published a very good description of *A. planosulcata*, along with representations of the shell with and without its expansions.

It is certain, also, that *Atrypa oblonga*, of Sow., and *Atrypa obtusa*, of M'Coy, are only slight modifications in shape of Phillips's species, and in the work on 'British Palæozoic Fossils' (p. 436), Professor M'Coy still considers *A. planosulcata* as distinct from his *A. paradoxa*, but with which opinion I am obliged to dissent. The author, moreover, observes that, "When the extended, flattened lamellæ are broken off, as is the case in the greater number of specimens, they only leave traces of obscure lines of growth (about ten in two lines), so nearly obsolete in the rostral portion that it seems smooth, but showing by their thickness, and the extreme obtuseness of the edge in specimens approaching ten lines in length, that to be the ordinary adult size, although I have seen some rather larger not bearing such marks of age. It is only close to, or immediately at, the margin that we find these paradoxical, greatly extended, shelly, flat, radiated lamellæ, which, if perfect, would considerably exceed the length of the shell in width. I imagine that they are found at the margins, because there the corresponding lamellæ of the two valves would come in contact and support each other; but, by growth of the shell, they would become separated when a new edge was formed between them, leaving them erect, insulated, and liable to be broken off by the slightest accident. The same thing occurs in *Tridacna squamosa*, where the great scale-like laminæ near the beak are always effaced, while those near the margin are perfect."

[1] 'Bulletin Soc. Geol. de France,' vol. xi, pl. iii, fig. 1.

Loc. In England *A. planosulcata* has been collected in the lower dark Carboniferous limestone of Lowick, in Northumberland; at Longnor, in Derbyshire; at Bolland; Settle; and in several other localities. In Scotland it has been met with in Lanarkshire, but is most abundant in Ireland, whence Mr. Kelly furnishes us with the following localities: Blacklion, Millecent, Little Island, Milverton. On the Continent it has been found by M. de Verneuil and De Koninck in the Carboniferous limestone of Visé, in Belgium.

ATHYRIS EXPANSA, *Phillips.* Pl. XVI, figs. 14, 16—18; Pl. XVII, figs 1.—5.

SPIRIFERA EXPANSA, *Phillips.* Geol. of Yorkshire, vol. ii, p. 220, pl. x, fig. 18.
ATRYPA EXPANSA, *J. de C. Sow.* Min. Con., pl. dcxvii, fig. 1 (the upper three large specimens only), 1840.
-- FIMBRIATA. Ibid., fig. 4 (not *Sp. fimbriata*, Phillips).
ATHYRIS EXPANSA, *M'Coy.* British Palæozoic Fossils, p. 433, 1855.

Spec. Char. Transversely elliptical, always very much wider than long; valves evenly and equally convex, often much depressed, with or without a gentle mesial depression in the ventral valve, no fold in the dorsal one; beak small, incurved; foramen circular and contiguous to the umbone of the opposite valve. External surface of both valves covered with fine, indistinct radiating lines or striæ, departing from the extremity of the beaks, and crossed by numerous concentric lines or ridges of growth. The spiral appendages occupy the larger portion of the interior. Dimensions very variable; three specimens measured—

Length 21, width 27, depth 11, without the lamellar appendages.
„ 16, „ 22, „ 8, ditto.
„ 10, „ 29, „ 6, ditto.

Obs. This species appears to be more variable in shape than *A. planosulcata*, from which it may be usually distinguished by its very transversely elliptical form, some specimens being almost twice and a half as wide as long (figs. 17, 18); and is often found in different states of malformation (Pl. XVII, figs. 2—4). The external surface is marked by faint radiating lines, which, according to Mr. J. de C. Sowerby, are intersected by "broad striated imbricating fringes," and of which a representation is given in pl. dcxvi, fig. 1, of the 'Mineral Conchology.' It is probable that these lamelliform prolongations were very similar to those of *A. planosulcata;* but as they were not present on any of the numerous individuals that came under my direct observation, I have contented myself with reproducing the statement made in the 'Mineral Conchology.'

Ter. fimbriata (Phillips) has been classed by some palæontologists among the synonyms of *A. expansa*, but although the author of the 'Geology of Yorkshire' has omitted to furnish

us with a figure of his species, and that his description—"orbicular, depressed; beak of the lower valve prominent but small; surface strongly radiated and concentrically imbricated," might be applicable to this or to other species, I am able to assert, from the inspection of the original example in the author's possession, that *T. fimbriata*, Phillips, cannot be placed among the synonyms of *A. expansa*, but would be more properly located with those of *A. Royssii*.

I am also quite of Professors M'Coy and De Koninck's opinion, while stating that *A. fimbriata*, figured by Mr. J. de C. Sowerby in the 'Mineral Conchology,' has been drawn from a specimen of Phillips's *A. expansa;* and it is likewise certain that some examples labeled and described as *A concentrica* (Buch), by Professor M'Coy, belong to the species we are now describing. *Sp. expansa* appears to have been subject to much malformation[1] if we are to judge from the number of specimens in that condition which abound in certain localities.

Loc. Common at Kendal, Westmoreland; Settle, in Yorkshire; at Bolland, and in the lower Carboniferous limestone of Hittor-hill, and Longnor, in Derbyshire, &c. In Ireland Mr. Kelly mentions Bruckless, Drumdoe, and Milverton. I am not acquainted with any Scottish examples.

ATHYRIS SQUAMIGERA, *De Koninck* (?). Plate XVIII, figs. 12, 13.

MARTINIA PHALŒNA, *M'Coy*. Synopsis of the Carboniferous Fossils of Ireland, p. 140, 1844. (Not *Spirifera phalœna* of Phillips's 'Figures and Descriptions of Palæozoic Fossils,' p. 71, pl. xxviii, fig. 123, 1841.)

TEREBRATULA SQUAMIGERA, *De Koninck*. Animaux Fossiles du terrain Carbonifere de la Belgique, p. 667, pl. lvi, fig. 7, 1851.

Spec. Char. Transversely oval, much broader than long; valves convex, sometimes gibbous; beak moderately produced, incurved, and truncated at its extremity by a small circular aperture. In the dorsal valve there exists a prominent mesial fold, and in the ventral one a sinus of variable depth, both commencing at a short distance from the extremity of the beaks. External surface ornamented with small imbricated striæ; interiorly there exists two spiral appendages, with their extremities directed outwards. Two specimens have measured—

Length 12, width 22, depth 9 lines.
„ 8, „ 16, „ 7 „

Obs. On comparing the specimen identified by Professor M'Coy as *Martinia phalœna* (our fig. 13) with Phillips's Devonian *Spirifera phalœna*, I was soon convinced that they

[1] Two of these specimens in the Museum of Practical Geology measure—
Length 23, breadth 33, depth 7 lines.
„ 25, „ 30, „ 7 „

did not belong to the same species, nor even to the genera to which they had been referred. Both are undoubted *Athyris's*, but the Carboniferous shell has puzzled me much, and it was only after having consulted Professor de Koninck that I ventured doubtfully to suggest that M'Coy's *M. phalæna*, and some other similar specimens I had obtained from Ireland, might perhaps belong to Professor de Koninck's *M. squamigera*, the peculiar reticulated surface still preserved on some portions of M'Coy's specimen (in the collection of Sir R. Griffith) being very similar to that described by the Belgian palæontologist. *Athyris squamigera* is stated by Professor de Koninck to be nearly related to *A. Royssii*, but that it differs by its greater transversity, depth of sinus, and external sculpture.

Loc. *A. squamigera* is mentioned by Mr. Kelly to occur in the Carboniferous limestone and calcareous slate of Lisnapaste, Clonea, St. Doulough's, in Ireland. Sir R. Griffith's specimen is labeled Ballinacourty, Dungarvan, and I have another from Millecent, Ireland. I am not acquainted with any English or Scottish examples. It was found in the Carboniferous limestone beds of Tournay, in Belgium, by Professor de Koninck.

ATHYRIS ROYSSII, *L'Eveillé*. Plate XVIII, figs. 1—11.

SPIRIFER DE ROYSSII, *L'Eveillé*. Mémoirs de la Société Géologique de France, vol. ii, p. 39, pl. ii, figs. 18—20, 1835.
— GLABRISTRIA, *Phillips*. Geol. of Yorkshire, vol. ii, p. 220, pl. x, fig. 19, 1836.
— FIMBRIATA. Ibid., p. 220, not figured.
TEREBRATULA ROYSSII, *De Verneuil*. Bulletin de la Société Géologique de France, vol. xi, p. 259, pl. iii, fig. 1, *b*, *c*, *d* (not 1, *a*, and *e*), 1840.
— — *De Koninck*. Animaux Fossiles du terrain Carbonifere de la Belgique, p. 300, pl. xxi, fig. 1 (but not pl. xx, fig. 1), 1843.
ATHYRIS DEPRESSA, *M'Coy*. Synopsis of the Characters of the Carboniferous Fossils of Ireland, p. 147, pl. xviii, fig. 7, 1844.
— DE ROYSSII, *M'Coy*. British Palæozoic Fossils, p. 433, 1855.
— GLABRISTRIA, *M'Coy*. Ibid., p. 434.

Spec. Char. Circular, or transversely oval; subglobose; beak incurved, and truncated by a small circular foramen which is contiguous to the umbone of the dorsal valve. The valves are almost equally and uniformly convex up to a certain age, after which a broad mesial fold of greater or lesser elevation is gradually formed in the dorsal valve, and a corresponding sinus in the ventral one. The frontal margin is, therefore, either nearly straight or presents a greater or lesser curve; the external surface is regularly covered by numerous concentric scaly ridges, from each of which radiate closely-set fringes of elongated, somewhat flattened spines. In the interior, the hinge is strongly articulated, the dental or rostral plates in the ventral valve offering, by their position, much solidity to the beak of the ventral valve. The hinge-plate is perforated close to its summit by a minute

circular aperture, and the spiral appendages for the support of the oral arms have their extremities directed outwards, and are united by a complicated system of lamellæ.

Dimensions and relative proportions very variable; two specimens have measured—

Without	the spinose expansion,	length	24,	width	33,	depth	15 lines.
With	ditto	„	32,	„	39,	„	17 „
Without	ditto	„	24,	„	26,	„	16 „
With	ditto	„	31,	„	32,	„	17½ „

Some examples have even slightly exceeded these dimensions, but the generality of specimens are much smaller.

Obs. This remarkable species has been often confounded with *Athyris plano-sulcata*, but from which it is easily distinguished by its spines, which are very different from the numerous large, concentric, lamelliform expansions of *A. plano-sulcata*; and it is from the generality of palæontologists having overlooked this circumstance, that they have so often confounded the two shells. So closely packed are the spinose ridges which invest the entire surface of *A. Royssii*, that no portion of the surface of the valve itself can be perceived, and I have counted as many as eighty of these pectinated fringes on one of the valves of a specimen which did not measure more than ten lines in length by thirteen in width. This arrangement will be easily understood by a glance at the enlarged representations (figs. 10 and 11), wherein a portion of the spines have been purposely omitted, so as to show the disposition of the pectinated expansions. The interior arrangements would appear to be exactly similar to those we have already described in *Athyris pectinifera*, and, indeed the two shells have been considered by several palæontologists as belonging to a single species.

As we have fully described and represented the interior dispositions in the Permian shell, and figured those also of another species of the same genus, *A. ambigua*, in Pl. XVII of the present monograph, it will not be necessary to repeat what has been already written.

In the limestone, on account of the hardness of the matrix, it is impossible to detach the specimen with its outer spinulous surface, and for this reason the shell, in that condition, was not recognised, and received from Professor Phillips the denomination of *Sp. glabristria*, while to the specimens from the shales which retained their spinous ridges the name of *Sp. fimbriata* was applied; but both will require to be added to the synonyms of L'Eveillés species, as well as that of *A. depressa* (M'Coy). Professor M'Coy observes, at p. 433 of his Cambridge work, that "The equal, thick, longitudinal spines, which fringe the narrow, concentric lamellæ of shale specimens (of the species under description), form an extremely marked character, and by their great strength and coarseness separate the species certainly from the Devonian *A. concentrica* of V. Buch." In Pl. XVIII, I have represented the shell under various aspects, and to which the reader is referred.

Loc. *A. Royssii* is a common shell in the Carboniferous limestone and shales of many localities. In England it was found at Bolland, in the Isle of Man, at Ulverstone, and

near Settle, in Yorkshire, &c. In Ireland, Mr. Kelly mentions Bundoran, Millecent, Little Island, Lisnaparte, Malahide, and Hook. In Scotland it is found at Brokley, near Lesmahago, at Craiginglen, and at West Broadstone, near Beith, in Ayrshire. On the Continent it was found at Tournay, and Pauquys, in Belgium, by Professor L. de Koninck, M. L'Eveillé, and others, &c.

ATHYRIS GLOBULARIS, *Phillips*. Plate XVII, figs. 15—18.

SPINIFERA GLOBULARIS, *Phillips*. Geology of Yorkshire, vol. ii, p. 220, pl. x, fig. 22, 1836.
ATHYRIS — *M'Coy*. British Palæozoic Fossils, p. 434, 1855.

Spec. Char. Subglobose; as wide, or wider than long; valves almost equally convex; beak moderately produced, incurved and truncated by a small circular foramen, which is contiguous to the umbone of the opposite valve. The sinus in the ventral valve, and the fold in the dorsal one, commence to appear at a short distance from the beaks, and divide the shell into three lobes of almost equal breadth; the sinus is of moderate depth, while the fold is more or less elevated. Surface smooth, marked only by a few concentric lines of growth. Shell-structure not perforated. In the interior, the spiral appendages for the support of the oral arms have their extremities directed outwards, and fill the larger portion of the shell. Dimensions variable; two examples have measured—

Length 11, width 12, depth 9 lines.
„ 9, „ 9, „ 8 „

Obs. *A. globularis* is closely related to both *A. ambigua*, Sowerby, and to *A. subtilata*, Hall. From the first it may, however, be distinguished by its more globose and uniformly convex appearance, the absence of that narrow median groove or depression in the dorsal valve (so characteristic of Sowerby's shell), as well as by the more regular inflation of the lateral portions of the valves. *A. ambigua* may be said to be obscurely divided into four lobes, while three would constitute the character of Phillips's species. From *A. subtilata*, *A. globularis* is principally distinguished by its transverse shape and more clearly defined mesial fold, Professor Hall's shell being longitudinally ovoid, or much longer than wide.

Loc. *A. globularis* occurs in the Carboniferous limestone of Bolland, Settle, in Yorkshire, and in several Derbyshire localities. Professor M'Coy states it to be common in the Carboniferous strata of Glasgow, and in that of Craige, near Kilmarnock; rare in the Carboniferous limestone of Dalmellington, Ayrshire, but whence I have not seen any well-authenticated specimens. On the Continent it has been found in the Carboniferous limestone of Visé, in Belgium, by Professor L. de Koninck.

ATHYRIS SUBTILITA, *Hall*. Plate I, figs. 21, 22. Plate XVII, figs. 8—10.

ATHYRIS GREGARIA, *M'Coy*. British Palæozoic Fossils, p. 435.

Obs. At p. 18 of this monograph, I described the shell here named as *Terebratula* (?)

subtilita, Hall, the material then at my command not being sufficient to enable me to determine positively whether it was a *true Terebratula* or an *Athyris*. Many excellent examples having subsequently turned up, I was able to assure myself that it was with the last-named genus that Professor Hall's species must be located, and now hasten to place it among its congeners. I also assured myself that the shell described by Professor M'Coy, in his work on 'British Palæozoic Fossils,' under the denomination of *Athyris gregaria*, belonged to Professor Hall's *A. subtilita*, and not to the shell which the same author had originally so designated in his 'Synopsis of the Characters of Irish Carboniferous Fossils,' and to which the term *gregaria* belongs.

Athyris subtilita occurs also in the Carboniferous limestone of Tournay in Belgium, and fig. 1, pl. xx, of Professor de Koninck's work on 'Belgian Carboniferous Fossils,' is referable to this species. At p. 714, of his 'Iowa Report,' Professor Hall states "that *T. subtilita* has a very wide range, being known in the eastern Ohio, Indiana, Illinois, Iowa, Missouri, Kansas, Nebraska, and Pecos village, in New Mexico." The British localities have been already mentioned.

RETZIA RADIALIS, *Phillips*. Plate XVII, figs. 19—21.

TEREBRATULA RADIALIS, *Phillips*. Geology of Yorkshire, vol. ii, p. 223, pl. xii, figs. 40, 41, 1836.

TEREBRATULA MANTIÆE, *De Koninck*. Animaux fossiles Carbonifere de la Belgique, p. 287, pl. xix, fig. 4, *a*, *b*, *c*, *d*, 1843 (not *T. mantiæ* of Sowerby).

ATRYPA RADIALIS, *M'Coy*. Synopsis of the Characters of the Carboniferous Fossils of Ireland, p. 156, 1844.

RETZIA RADIALIS, *Morris*. A Catalogue of British Fossils, p. 145, 1854.

SPIRIGERINA (?) RADIALIS, *M'Coy*. British Palæozoic Fossils, p. 438, 1855.

Spec. Char. Circular or longitudinally ovate; valves almost equally and moderately convex, without fold or sinus; margin of valves almost straight. Each valve is ornamented by about twenty small, rounded, radiating ribs, of which the central one in the dorsal valve is at times the largest, and to which, in the ventral valve, corresponds a deeper sulcus; but this difference is not always apparent, and in some specimens the dorsal valve appears for some distance divided by a median depression, from which arises a central rib. The beak is more or less produced and truncated by a circular foramen, which is more or less separated from the hinge-line by a small triangular area. Shell-structure punctate. Interiorly, two spiral appendages, with their extremities directed outwards, exist for the support of the oral arms. Two examples have measured—

Length 5, width 5, depth 3 lines.

„ 4, „ 4, „ 3 „

Obs. This little *Retzia* was in 1843 mistaken by Professor de Koninck for Sowerby's *T. mantiæ*, but the distinguished Belgian palæontologist subsequently discovered and

admitted his mistake. Professor Phillips describes his shell as follows: "Orbicular; no mesial fold; ridges equal, rounded, radiating." This diagnosis will agree with many of the specimens, but the peculiarity presented by the central rib and corresponding sulcus in the opposite valve are characters not to be overlooked, as well as the small triangular area which is not represented in the figures of the shell given in the 'Geology of Yorkshire.' In England, *R. radialis* has been obtained from the Carboniferous limestone of Bolland, also by Mr. Burrow in the lower scar limestone of Settle, Yorkshire; and Professor M'Coy mentions it from Derbyshire. In Ireland it was found, according to Mr. Kelly, at Bruckless, Malahide, and Millecent, in the Carboniferous limestone and calcareous slate. In Scotland it has been discovered near Lesmahago by Dr. Sliman. In Belgium it has been collected at Visé and Tournay by Professor de Koninck; and by the authors of the 'Geology of Russia' in the Carboniferous limestone of Zaraisk, in the government of Riaisan, Russia.

RETZIA ULOTRIX, *De Koninck*. Plate XVIII, figs. 14, 15.

TEREBRATULA (CRISPATA) ULOTRIX, *De Koninck*. Animaux fossiles de la Belgique, p. 292, pl. xix, fig. 5, 1843.

Spec. Char. Somewhat circular or slightly transverse; moderately convex, without fold or sinus; each valve is ornamented with from seven to nine angular ribs, of which the three central ones are the largest and most prominent; the beak of the ventral valve is somewhat produced, straight, but slightly incurved, and truncated by a small circular foramen, a flattened triangular area existing between it and the hinge-line. Shell-structure punctate. Interiorly there exists two spiral appendages, with their extremities directed outwards for the support of the oral arms.

Dimensions variable; two British examples have measured—

Length 6, width 6, depth 3 lines.

„ 2, „ $2\frac{1}{3}$, „ 1 „

Obs. This little *Retzia* was first described by Professor de Koninck under the designation of *T. crispata*, but in the explanation of his plate the name was altered to that of *T. ulotrix*, from the author having found that the first denomination had been already employed. I am acquainted with only two English examples of this shell, one, from Bolland, I found in the British Museum; the other, from the Carboniferous limestone of Wetton, in Derbyshire, is in the Museum of Practical Geology; and upon sending drawings to Professor de Koninck, I was assured that they were referable to his species. This shell is stated to be likewise very rare in Belgium, and is found in the Carboniferous limestone of Tournay, where it would appear to have attained somewhat larger dimensions, the specimen figured by Professor de Koninck measuring—

Length $6\frac{1}{2}$, width $7\frac{1}{2}$, depth 4 lines.

R. ulotrix is easily distinguishable from *R. radialis* by its fewer and larger ribs, as well as by other peculiarities.

In recapitulation it may be mentioned that the most active research has not enabled me to recognise more than seven or eight species of *Athyris*, and two of *Retzia*, in the British Carboniferous deposits. These may be arranged in the following order, and those that are most closely related have been connected with a brace:

ATHYRIS.
1. Athyris planosulcata, *Phillips.*
2. — lamellosa, *L'Eveillé.*
3. — expansa, *Phillips.*
4. — Royssii, *L'Eveillé.*
5. — squamigera (?) *De Koninck.*
6. — ambigua, *Sowerby.*
7. — globularis, *Phillips.*
8. — subtilita, *Hall.*

RETZIA.
1. Retzia radialis, *Phillips.*
2. — ulotrix, *De Koninck.*

Family—RHYNCHONELLIDÆ.

The only two genera belonging to this family that have been hitherto discovered in British Carboniferous strata are *Rhynchonella*, Fischer ('Introduction,' p. 93), and *Camarophoria*, King ('Introduction,' p. 96, and 'Permian Monograph,' p. 23). The genus *Pentamerus* has been recorded by Professor M'Coy, but the species so referred to belongs to *Cyrtina*, and not *Pentamerus*, as will be found explained at p. 66 of the present Monograph.

After a very lengthened and difficult study of the various species of *Rhynchonella* and of *Camarophoria* stated to have been found in the Carboniferous rocks of Great Britain, I have ventured to refer the whole to the following species:

RHYNCHONELLA.
1. Rhynchonella reniformis, *Sowerby.*
2. — cordiformis, *Sowerby* (still doubtful).
3. — acuminata, *Martin.*
4. — pugnus, *Martin.*
5. — pleurodon, *Phillips.*
6. — flexistria, *Phillips.*
7. — angulata, *Linnæus.*
8. — trilatera, *De Koninck.*

Camarophoria.	1.	Camarophoria crumena, *Martin.*
	2.	— globularis, *Phillips.*
	3.	— (?) laticliva, *M'Coy.*
	4.	— isorhyncha, *M'Coy.*
Doubtful species of Rhynchonella or Camarophoria.	1.	Rhynchonella or Camarophoria (?) proava, *Phillips.*
	2.	— semisulcata, *M'Coy.*
	3.	— gregaria, *M'Coy.*
	4.	— nana, *M'Coy.*

So that out of upwards of thirty so-termed species recorded by various palæontologists, or geologists, as having been found in the Carboniferous rocks of Great Britain, but seven of *Rhynchonella*, and three or four of *Camarophoria*, appear to me as worthy of being retained; all the others, with the exception of three or four still doubtful forms, are either synonyms or names of species that have not in reality been hitherto discovered in Great Britain. The extent of variations in shape and even character assumed by certain species is quite perplexing; for instance, *Rh. acuminata* is at times entirely smooth, or is covered more or less with ribs; sometimes it is a heart-shaped shell, while at other times it is completely depressed and almost flattened; still, every passage connecting these extreme cases can be easily recognised, and it should warn the palæontologist of the necessity of founding his appreciations, not from the study of one or two specimens only, but from the inspection of a large series of its varieties.

Notwithstanding all the care and trouble I have taken in the endeavour to determine as correctly as possible the limits of the various species, I cannot pretend to have always succeeded, and would strenuously advise the reader to study the matter independently, and not to blindly adopt the views here recorded, as certain of them may eventually prove erroneous.

In order to facilitate research, I have carefully selected and represented all the more important variations assumed by each species, as I have always considered the illustration of a typical form only, to be insufficient as it does not generally convey to the mind the true average characters of the species (if I may be permitted the use of such an expression).

Rhynchonella reniformis, *Sowerby.* Pl. XIX, figs. 1—7.

Terebratula reniformis, *Sowerby.* Min. Con., pl. ccccxcvi, figs. 1—4, Sept. 1825.
— — *Phillips.* Geology of Yorkshire, vol. ii, p. 222, pl. xii, figs. 13—15, 1836.
Hemithyris — *M'Coy.* British Palæozoic Fossils, p. 441, 1855.
Rhynchonella — *Morris.* A Catalogue of British Fossils, p. 146. 1854.

Spec. Char. Transversely reniform, wider than long; dorsal valve more or less

elevated or gibbous; profile much arched, especially at the umbone, which projects further than the extremity of the beak; externally the valve is divided into three portions or lobes, of which the central one forms a mesial fold of but small elevation, and composed of three, four, or five ribs, these becoming obsolete close to the umbone; the lateral portions or lobes are inflated and smooth. In the ventral valve the beak is small and much adpressed, the sinus deep and wide, with two or three longitudinal ribs along the middle; the lateral portions of the valve are smooth, and more or less inflated, usually extending lower down than the margin, and to meet which they are abruptly bent. The entire external surface of shell is covered with minute, longitudinal, radiating striæ. Dimensions and proportions very variable; three specimens have measured—

Length 14, width 18, depth 15 lines.
„ 13½, „ 16½, „ 16 „
„ 12, „ 14, „ 13 „

Obs. Some difference in opinion has been expressed as to the specific value of *Terebratula reniformis*;[1] thus, in 1843, it was placed by Professor de Koninck among the synonyms of *R. acuminata*, but from which the same author removed it at a subsequent period.

In the same year (1843) Sowerby's *T. cordiformis* had also been considered by Professor de Koninck as a variety of *R. acuminata*, and my distinguished friend still adheres to the same opinion, although the generality of palæontologists maintain the three as separate species. How far this last view is correct I am not yet perfectly prepared to decide, notwithstanding the long and careful examination I made of the original types, along with many other specimens of the same species.

It is very difficult, nay, quite impossible, to express by words alone those minute differences which at times distinguish two closely allied species; I have, therefore, spared no trouble in carefully selecting and representing all those specimens which may enable the reader to form an opinion for himself, and especially so as I have still some misgivings as to the exact position *R. cordiformis* should occupy; that is to say, whether it should be viewed as a distinct species, or as a variety of *R. reniformis* or *R. acuminata*.

The general characters and facies of *Rh. acuminata* and *R. reniformis* appear to me sufficiently defined, and not to be confounded; the remarkable inflation of the umbone of

[1] I here reproduce the original description:

"TEREBRATULA RENIFORMIS, *Sow.* Vol. v, p. 496, tab. ccccxcvi, figs. 1—4.

"*Spec. Char.* Reniform; middle furnished with three or four longitudinal, rounded ridges, terminated by acute plaits in the much-elevated margin in the front; sides inflated below the entire edges; a much-rounded, almost two-lobed, inflated, and more or less depressed, shell. The form of the ridges and intermediate furrow is very remarkable, being rounded, while the corresponding notches in the margin are acute-angular. The peculiar form of the sides of the beaked valve, which are inflated so as to hang below the edges, will distinguish all the varieties of this species. Very abundant in the mountain limestone of Dublin and Cork."

the dorsal valve, which generally projects beyond the level of the beak, the curious convexity of the smooth lateral portions of both valves, and especially of the ventral one, which present the unusual appearance of hanging below the margin (as noticed by Sowerby), are not, to my knowledge, characters ever seen in *R. acuminata*. The last-named shell is also generally much more elevated in front, and the frontal commissure of the valves is peculiar, and different from that of *R. reniformis*.

The shell under description is usually transverse, with three or four ribs on the fold, and two or three in the sinus; five on the fold, and four in the sinus, are of much rarer occurrence. In the 'Geology of Yorkshire,' Professor Phillips represents two specimens, without mesial fold or ribs, as varieties of *R. reniformis*, but it appears doubtful to me whether these very exceptional specimens are properly defined.

Loc. Rh. reniformis is not a rare fossil in the Carboniferous limestone of Bolland, of Settle, in Yorkshire, at Twiston, in Lancashire, and in the Isle of Man, &c. In Ireland, Sowerby mentions Dublin and Cork, and Mr. Kelly adds Lisnapaste, Millecent, and Little Island. I am not certain whether the species really occurs in Scotland, at least I have not seen any well-authenticated examples.

Rhynchonella cordiformis, *Sowerby*. Plates VIII, IX, X.

Terebratula cordiformis,		*Sowerby*.	Min. Con., vol. v, p. 495, tab. ccccxcv, fig. 2, 1825.
Atrypa	—	*M'Coy*.	Synopsis of the Carboniferous Fossils of Ireland, p. 152, 1844.
Rhynchonella	—	*Morris*.	A Catalogue of British Fossils, p. 446, 1854.

Spec. Char. Obscurely pentagonal, either slightly wider than long or longer than wide; dorsal valve gibbous, front much elevated, with three or five ribs on the mesial fold, which become obsolete before reaching the extremity of the umbone; profile arched; the lateral portions of the valve are convex and tumid. In the ventral valve the beak is small and often adpressed; the sinus is wide and deep, with from two to four ribs along its middle; the lateral portions of the valve are smooth, and do not hang below the margin of the opposite one. Dimensions variable; three examples have measured—

Length $13\frac{1}{2}$, width $16\frac{1}{2}$, depth 16 lines. (Sowerby's type.)
„ 12, „ 14, „ 13 „
„ 9, „ 10, „ 9 „

Obs. It is with much doubt and many misgivings that I here provisionally introduce *Ter. cordiformis* as a separate species, and in this respect I have followed both Professors M'Coy and Morris. Sowerby describes his shell as "heart-shaped; front much elevated, with a deep sinus in the margin; sides rather convex, sharp edged; middle ornamented with several acute furrows reaching to the beaks;" that it "differs from *Ter. acuminata*

in being much more tumid in the middle, and in having three or more sharp angular furrows, extending along the middle of the large marginal sinus almost to the beaks, and is very variable in magnitude." A single specimen is represented by the author, and of this I have given four carefully drawn representations (fig. 8). In his 'Synopsis,' Professor M'Coy states that "*R. cordiformis* is chiefly distinguished from one of the varieties of *A. acuminata* by being more convex or tumid at the sides, and in the length and distinctness of the mesial plaits." Professor de Koninck, on the contrary, believes *R. cordiformis*, or at least the specimen described as such by Sowerby (fig. 8 of our plate), to be nothing more than a simple variety of *Rh. acuminata;* and although I am not yet perfectly convinced of the fact, it is very possible that my Belgian friend may be correct in his interpretation. In British collections, however, the shells which we usually designate *R. cordiformis*, and of which one or two examples so labeled exist in Sowerby's cabinet, are similar to those I have represented by figs. 9 and 10, and which are supposed to belong, rightly or wrongly, to the same species as Sowerby's type. These Professor de Koninck considers quite distinct from either *R. acuminata* or *R. reniformis*, since he sends me an Irish specimen marked "nov. sp.," and on the label points out the differences he had observed.

I must admit that I am still much puzzled how to decide; for I once even supposed that the last-named shells might, perhaps, constitute a variety of *R. reniformis*, and that Sowerby himself may have had a similar idea, from the fact that he figures among his specimens of *R. reniformis*, in tab. ccccxcvi of the 'Mineral Conchology,' a specimen very similar to the two I have represented (figs. 9 and 10), but without reference, as if he afterwards doubted the identity. If it should be determined that the typical example of *R. cordiformis* must be referred to *R. acuminata*, and that the other two (figs. 9 and 10) are distinct, I think the name *Cordiformis* might be advantageously retained for these last, as they have been so long known under that designation among British collections.

Loc. The shells here described are generally found in the Carboniferous limestone, associated with *R. reniformis*. Mr. Burrow has obtained it at Settle, in Yorkshire, and I have specimens from Bolland. In Ireland Messrs. Kelly and Morris mention Millecent, Little Island, Cork, and Ardconnaught. I am not acquainted with any Scottish specimen, but Professor de Koninck has figured the shell from Belgium.

RHYNCHONELLA ACUMINATA, *Martin* (sp). Plate XX, figs. 1—13; Plate XXI, figs. 1—20.

CONCHYLIOLITHUS ANOMITES ACUMINATUS, *Martin*. Petrif. Derbs., pl. xxxii, figs. 7, 8; and pl. xxxiii, figs. 5, 6, 1809.

TEREBRATULA ACUMINATA, *Sowerby*. Min. Con., tab. cccxxiv, fig. 1, Jan. 1822.

— — var. *sulcata*, *Sowerby*. Ibid., tab. ccccxcv, fig. 3, Sept. 1825.

— PLATYLOBA, *Sowerby*. Ibid., tab. ccccxcvi, figs. 5, 6, 1825.

— ACUMINATA, *V. Buch*. Ueber Terebratula, p. 33, 1834; and Mem. Soc. Geol. de France, vol. iii, p. 131, pl. xiv, fig. 1, 1838.

TEREBRATULA ACUMINATA, *Phillips*. Geology of Yorkshire, vol. ii, p. 222, pl. xii, figs. 4—9, 1836.

— MESOGONIA. Ibid., pl. xii, figs. 10—12.

— ACUMINATA, *De Koninck*. Animaux fossiles de la Belgique, p. 278, pl. xvii, fig. 3, *a*, *b*, *c*, *d*, *f* (not the other figures), 1843.

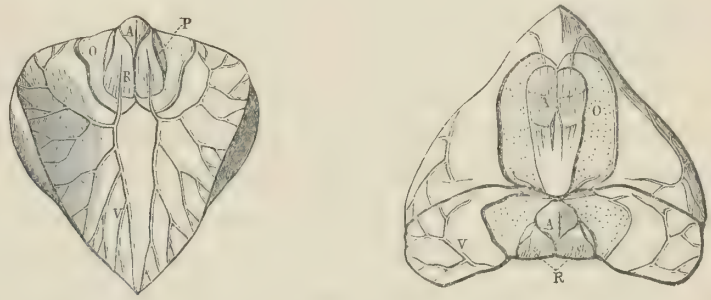
ATRYPA ACUMINATA, *M'Coy*. Synopsis of the Characters of the Carboniferous Fossils of Ireland, p. 151; also woodcut, fig. 32, 1844.

— — *D'Orbigny*. Prodrome de Paléontologie Stratigraphique, vol. i, p. 146, 1849.

RHYNCHONELLA ACUMINATA, *Morris*. A Catalogue of British Fossils, p. 146, 1854.

HEMITHYRIS — *M'Coy*. British Palæozoic Fossils, p. 381, 1858.

Spec. Char. Very variable in shape and character; more or less trigonal, heart-shaped, or obscurely pentagonal; generally wider than long. Dorsal valve convex, often gibbous, and much elevated at its frontal margin, the lateral portions sloping rapidly on either side; a distinct mesial fold is rarely perceptible. Beak in ventral valve small, incurved; foramen minute, situated under the extremity of the beak, and margined by a deltidium. Sinus either concave or angular, of great width, and of variable depth; originating at a short distance from the extremity of the beak, it extends to the front, where it forms either a regular curve or is prolonged in the shape of an acute cuneiform extremity. Externally the surface is smooth, finely striated, or more or less strongly plaited.



Ventral aspect. Umbonal aspect.

Rh. acuminata, internal casts.

A. Adductor, or occlusor. R. Cardinal, or divaricator. P. Pedicle, or ventral adjustor, muscular impressions. V. Vascular markings. O. Ovarian spaces.

In the interior of the dorsal valve the hinge-plate is divided, and to these are attached a pair of short, curved, shelly processes, for the support of the oral arms. On the bottom of the valve may be seen the quadruple impressions produced by the adductor or posterior and anterior occlusor muscle of Hancock; and in the ventral valve the adductor (or occlusor), cardinal (or divaricator), and pedicle (or ventral adjustor) muscular scars may be distinctly traced. The ovarian and vascular spaces and impressions are also clearly defined in the interior of both valves. Dimensions very variable; four examples have offered the following proportions :

Length 25, width 26, depth 19 lines.
„ 15, „ 17, „ 22 „
„ 19, „ 20, „ 11 „
„ 15, „ 19, „ $7\frac{1}{2}$ „

Obs. At page 222 of his 'Geology of Yorkshire,' Professor Phillips has stated that the varieties of *T. acuminata* are almost innumerable, and that a specific character was at that time impossible. If, therefore, such was the case in 1836, I do not believe that matters have materially improved since that period. It is at all times most difficult, nay impossible, to convey in a diagnosis a sufficiently accurate description of a species, and especially of so variable a one as that now before us; and as figures always convey a more accurate idea of any object than words alone are able to express, I have represented in Plates XX and XXI all the principal and more important variations, both of specimen and age, assumed by this species, and which have been selected with great care from among some hundred specimens I was able to assemble from various collections and localities. Every intermediate link can be found connecting such extreme cases as those, Pl. XX, fig. 1, and Pl. XXI, fig. 11, and the want of space alone has prevented their being all here represented. The first notice I find of this remarkable shell consists of two very good figures of the typical variety, published by Andreae, in his 'Lettres écrites de la Suisse,' pl. xiv, 1763, and which illustrations very closely agree with those published by Martin forty-four years later. Several authors have referred fig. 1 of pl. ccxlvi, of the 'Encyclopédie Méthodique,' published by Bruguière, in 1788, to *T. acuminata*, and it may have been drawn from an example of the species, but it bears also much resemblance to some specimens of De Verneuil and Keyserling's *Rh. Meyendorfii*, and is not so good or so characteristic a representation as that by Andreae, above mentioned. It was, however, only in 1809 that the shell received a specific denomination, and that of *acuminata* was bestowed upon it by Martin,[1] who gave us at the same time a good description and correct figure of two of its varieties, and which agree also very closely with those I have represented in Pl. XX, fig. 2, and in Pl. XXI, fig 1. These will require to be looked upon as the typical shape of the species.

In 1822 James Sowerby describes and figures the same form, and in 1825 he represented two other of its varieties, which he designated by the names *sulcata* and *plicata*, and to a third he applied the specific denomination of *platyloba*. In 1836 Professor

[1] Martin describes his species in the following words:

"Conchyliolithus anomites (*acuminatus*) cordiformis lævis, sinu margine longissimo cuneato, s. p.

"A petrified shell; the original an *Anomia*. Perforate; both valves convex, cordiform or heart-shaped, and smooth, the surface being destitute of striæ, furrows, or tubercles (the larger specimens, under a glass, appear to be marked with very minute, close, and equal striæ). The hinge curved, and close. Foramen very minute, under the apex of the beak, which is small, sharp-pointed, and incumbent. The larger or beaked valve hollowed at the back into a single wave, ending in a very long, sharp-pointed, cuneiform, or wedge-shaped sinus at the margin. This very curious Anomite is not uncommon near *Bakewell* and *Buxton*, in the limestone strata; it varies considerably in size."

Phillips judiciously united into one species *T. acuminata* and *platyloba*, as well as the above-named varieties, but was perhaps mistaken while forming a new and separate species, *T. mesogonia*, for what seems to be a small variety of the typical shape of Martin's shell, and which the distinguished author of the 'Geology of Yorkshire' himself states to be "a miniature copy of the first var. of *T. acuminata*." Such would appear to be the named varieties and synonyms of the species under description, but it is necessary here also to record that several Palæontologists, and especially Professor M'Coy, would go still further, by adding *Rh. pugnus*, of Martin, to the varieties of *R. acuminata*; and although I am ready to admit that some extreme and exceptional shapes of both may be difficult to determine, and might lead to the idea of a passage, still the generality of specimens of both species appear to me so distinct that I would not feel myself justified in subscribing to the opinion advocated by the distinguished Irish professor.

In his great work on 'Belgian Carboniferous Fossils,' published in 1843, Professor de Koninck had assembled, as synonyms of *Rh. acuminata*, several species which he subsequently admitted to be distinct, at p. 664 of the supplement to that work, published in 1851, and among other observations he states it to be his decided opinion that *R. pugnus* is specifically distinct from *R. acuminata*.

Long and careful observations, based upon the study of many specimens, has induced some palæontologists as well as myself to consider that, although the typical form of the species under description may be heart-shaped, smooth, with a long, sharpened, pointed, cuneiform sinus (as described by Martin and others), the greater number of specimens did not present that character, the sinus being more uniformly rounded in front, and regularly or irregularly marked with rudimentary or prominent ribs, and of these Sowerby has formed his varieties *sulcata*, *plicata*, and *platyloba*. In Pl. XXI, fig. 10, a specimen is represented in which the ribs extend from the frontal margin to nearly the extremity of the umbone, and if the reader will again look at Pl. XXI, he will find that in figs. 1, 2, and 3, the fold, or what corresponds to it, is smooth and acute, while in fig. 4 it is divided into two, in fig. 5 into three; fig. 6 shows five ribs, and so on until the fold and sinus become regularly and numerously plaited, as in figs. 7, 10, and 11. The great elevation of the front is also at times gradually replaced by a more gentle curve, and in the young state especially the whole shell very often appears to be but slightly convex, and is even depressed, as in figs. 14—20 of the same plate. In the generality of specimens we find not a vestige of a rib on the lateral portions of the valves, but in other rarer examples these are sometimes present near the margin, and it is specimens so constructed that approach most in shape to *Rh. pugnus*. All this extreme variability, offered by a single species, shows how cautious we should be in our appreciations of specific characters, and especially so when we are unavoidably deprived of all anatomical assistance.

Mr. Hancock has stated in his admirable 'Memoir on the Anatomy of the Brachiopoda,' published in the 'Philosophical Transactions of the Royal Society' for 1858, that two

forms, externally almost undistinguishable, have been found by him to possess animals so different in their anatomical details that they could not, in his opinion, be confounded under the same specific denomination ; and it has been shown, by other similar investigations, that shells presenting a wide range of external modifications of detail possessed an animal exactly similar. This demonstrates the almost impossibility of very often determining among the extinct forms what in reality belongs to the same species ; and our appreciations must therefore be always more or less uncertain, however much zeal we may display in our attempt to dive into the veiled secrets of nature.

Professor M'Coy was mistaken while stating, at p. 151 of his ' Synopsis of the Carboniferous Fossils of Ireland,' that the internal structure of *R. acuminata* was similar to that of *T. hastata*, the one being a *Rhynchonella*, the other a *Terebratula ;* but his imperfect woodcut representation (fig. 32 of the ' Synopsis') would denote that the Professor had observed the two small curved supports of the oral arms in *Rhynchonella acuminata.* In Pl. XX, fig. 6, the reader will find a more complete representation of the interior of the dorsal valve, and the two woodcuts given above show the shape of the muscular and vascular impressions.

Loc. *R. acuminata* and its varieties abound in the Carboniferous limestone of many English and Irish localities, but no well authenticated Scottish examples have hitherto come under my observation. Martin mentions Bakewell and Buxton, in Derbyshire. It is very common about Clitheroe and Bolland, in Lancashire, and at Park Hill, Longnor, Derbyshire ; at Settle and Malham Moor, in Yorkshire ; in the Isle of Man, &c.

In Ireland, Mr. Kelly mentions Mullaghfin, Millecent, Little Island.

On the Continent *R. acuminata* was found at Visé, in Belgium, by Professor L. de Koninck ; at Hausdorf, by M. De Semenow ; and at Cosatchi-Datchi (Oural), by M. de Verneuil and Count Keyserling, &c.

Rhynchonella pugnus, *Martin* (sp.). Pl. XXII, figs. 1—15.

Conchyliolithus anomites pugnus, *Martin.* Petrificata Derbiensia, tab. xxii, figs. 4, 5, 1809.

Terebratula pugnus, *Sowerby.* Min. Con., tab. ccccxxv, figs. 1—6, 1825.

— — *Phillips.* Geology of Yorkshire, vol. ii, p. 222, pl. xii, figs. 17 (but fig. 16 should also be included), 1836.

— sulcirostris, *Phillips* (?). Geology of Yorkshire, vol. ii, p. 222, pl. xii, figs. 31, 32, 1836.

Atrypa pugnus, *M'Coy.* Synopsis of the Characters of the Carboniferous Fossils of Ireland, p. 156, 1844.

— laticliva, *M'Coy* (?). Ibid., p. 154, pl. xxii, fig. 16.

Terebratula pugnus, *De Verneuil* and *Keyserling.* Geology of Russia, vol. ii, p. 78, pl. x, fig. 1, 1845.

Hemithyris acuminata, var. *pugnus, M'Coy.* British Palæozoic Fossils, p. 338, 1852.

Spec. Char. Shell very variable in shape, transversely ovate or oblato-deltoidal; wider than long; dorsal valve gibbous, most elevated near the front, evenly convex at the umbone; mesial fold large, and more or less prominent. Ventral valve less convex than the opposite one, with a sinus of moderate depth, commencing at a short distance from the beak, and extending to the front. Beak small, much incurved, and contiguous to the umbone; foramen minute, placed under the extremity of the beak, and but rarely visible in full-grown shells. Each valve is ornamented with from nine to fourteen ribs, which become obsolete as they approach the beak and umbone; from three to six occupy the fold and sinus.

Three examples measured:

Length 12, width 17, depth 12 lines. (Martin's type.)

„ 24, „ 24, „ 20 „

„ 11, „ 15, „ 10½ „

Obs. This, and *R. acuminata*, are certainly the *Rhynchonellæ* at present known in the Carboniferous period which appear to have attained the largest proportions, and although believed by the generality of palæontologists to be specifically different, and in general easily distinguishable, it cannot be denied that there are exceptional examples, which from their intermediate shape would go some length to support the opinion expressed by Professor M'Coy, viz., that *R. pugnus* might be nothing more than a variety of *Rh. acuminata*.[1]

In 1809 Martin published two somewhat enlarged representations of what we must consider to be an abnormal shape and injured specimen of the species under description; nor did Sowerby neglect to mention that had he not possessed the individual specimen (which I have also seen and drawn) he would have felt some uncertainty as to its identity with the specimens he subsequently figured in tab. ccccxcvii of the 'Mineral Conchology.'

In very large, full-grown examples, such as in figs. 3—6 of my plate, the posterior half or upwards of each valve is evenly convex, and exhibits no trace of ribs, but these are always present round the margin and on the anterior portion of the valves. This is also the case with the generality of young shells; but in the larger number of middle-sized specimens the mesial ribs, or those which compose the fold and sinus, extend to more than

[1] 'British Palæozoic Fossils,' p. 381. Professor M'Coy proposes to subdivide his *Hemithyris acuminata* into four named varieties, viz.:

"1st var., — *acuminata* (Martin). Front sinus very high, acutely angular, few or no traces of mesial plaits, nor lateral marginal plaits, except in very large specimens.

"2d var., — *platyloba* (Sow.). Transversely ovate, plaits obtuse.

"3d var., — *pugnus* (Martin). Rhomboidal tumid; three to six mesial, and three or no lateral, short, strong plaits.

"4th var., — *mesogonia* (Phill.). Form and other characters exactly as in the type, var. *acuminata*, but the width less than one inch."

half the distance, and sometimes even reach nearly to the extremity of the beak and umbone. This character is well exhibited in Martin's type, and may be seen likewise in figs. 9 and 16 of my plate. The specimen represented in the 'Petrificata Derbiensia' exhibits five large rounded ribs on the mesial fold of the dorsal valve, and four in the sinus of the ventral one, these last being indented or grooved along their centre to the distance of a couple of lines from the margin; but the shorter ribs on the lateral portions of the valves are not so marked, nor do they extend to any great distance from the margin. Now if we examine a large number of specimens of *R. pugnus*, it will be seen that in the generality of young and middle-sized examples the ribs are acute, and rarely present the indentation along the middle; this last-named peculiarity is common, but not general, to a smaller species, *R. pleurodon*, and I must hasten to observe that although by far the larger number of specimens of the last-named shell appear to be well distinguished from *R. pugnus* by the more numerous ribs which cover the entire surface of the valves; in some exceptional cases they become likewise gradually obsolete as they approach the beak and umbone, and in which condition are less easily separable from Martin's shell.

The prevailing number of ribs on the mesial fold in *R. pleurodon* is five, but that number is the exception in *R. pugnus*, where three, four, and six on the fold; and two, three, and five in the sinus would appear to be the usual number. The ribs are likewise sharper in young specimens, or races from certain localities than from others, and in this condition approach most to *R. pleurodon*. The surface of the valves, when perfectly preserved, appear to be finely striated, as is also the case with *R. acuminata* and some other species.

In young specimens of the shell under description the beak is acute, and but slightly incurved, and in this state the small circular foramen surrounded by its deltidium may be distinctly observed, but in more aged individuals, from the beak becoming much incurved over the umbone of the opposite valve, the aperture can no longer be seen. Some specimens are also much more transverse than others, and but few appear to have attained the dimensions of the larger ones represented in our plate. From *R. acuminata* and *R. reniformis*, Martin's shell may be distinguished by its lateral ribs.

The interior arrangements and impressions are those of the genus *Rhynchonella*. In the dorsal valve the shelly processes (for the support of the spirally coiled brachial appendages) consist of two short, flattened, grooved lamellæ, separate and moderately curved upwards (Pl. XXII, fig. 13), being prolongations of a deeply divided hinge-plate. Four muscular impressions produced by the adductor or occlusor muscle are visible on the bottom of the valve. In the ventral valve the hinge-teeth are supported by dental plates; scars formed by the adductor or occlusor; cardinal or devaricator; and ventral adjustor muscles may be distinctly recognised, as well as the vascular markings. Professor M'Coy appears to have been the first naturalist who observed in this species the slender curved lamellæ above described; for, at p. 156 of his 'Synopsis,' we find a woodcut representation

which, although very defective and imperfect in drawing, conveys some idea of the arrangement.

The intimate shell structure does not differ in any respect from that which is common to its congeners.

In 1825, Sowerby represented several examples or variations in shape of the shell under description, observing, at the same time, that out of several hundred specimens, hardly two could be found alike; he mentions, likewise, that *Ter. lateralis* ('Min. Con.,' tab. lxxxiii, fig. 1), may probably be a variety or shape of *R. pugnus;* but as the original specimen could no longer be found in the Sowerby collection, and as the figure is insufficient, all that can be said is, that whether the specimen be referable to *R. pugnus*, or to *R. angulata*, it will require to be added to the synonyms.[1]

In 1836, Professor Phillips described and figured a Rhynchonella by the name of *T. sulcirostris*. "Rhomboideo-deltoidal; edge sharp, plaits obtuse, mesial plaits five to nine; upper valve (our dorsal) sulcate towards the beak"[2] (fig. 16, of my plate); and I have felt much puzzled how to deal with this species (?), for I could not satisfactorily recognise the original specimen, in the Gilbertsonian collection, all those bearing the name *sulcirostris* appearing to be nothing more than variations in shape of *R. pugnus*, in which the ribs on the fold and sinus have extended to nearly the extremity of the beak, and thus agreeing also with what we perceive to have been the case with Martin's type. *R. sulcirostris* appears to be one of those undecided shapes, bearing some resemblance to *R. pleurodon*, of which Mr. Morris has supposed it a synonym; but the shortness of the lateral ribs, as depicted in the figure, would assimilate it more closely to certain varieties of *R. pugnus*, than to *R. pleurodon*, which does not present that appearance. It appears to me, however, almost certain that the shell in question is a true *Rhynchonella*, and not a *Camarophoria*, as described by Professor M'Coy, at p. 446 of his 'British Palæozoic Fossils,' and it is evident that the last-named author must have had before him some other species while drawing up his description; but as he does not furnish us with a representation of his shell, it is impossible for me to offer any further opinion on the subject. It must also be remarked that the large specimen drawn in pl. xii, fig. 16, of the 'Geology of Yorkshire,' would be more properly located with *R. pugnus*, than with *R. pleurodon*.

The description and figure Professor M'Coy gives us of his *Atrypa laticliva*, at p. 154[3]

[1] I have reproduced Sowerby's description of *R. lateralis*, under *R. angulata*, and the figure will be found in Pl. XXV, fig. 14.

[2] Phillips's 'Geology of Yorkshire,' vol. ii, p. 222.

[3] "Transversely rhomboidal, length two thirds the width, gibbous; middle of the shell elevated in front, with three obtuse ribs, reaching nearly to the beak; between the mesial elevation and the sides is a smooth space, equal in breadth to the mesial elevation; sides small, compressed, with three obtuse ridges reaching half way to the beak. This species is remarkable for the small number of ribs, and the broad space between those of the mesial elevation and the sides; length 6 lines, width 9 lines."

of the 'Synopsis,' has induced both Professor De Koninck and myself to suppose that the author had before him some specimen of *R. pugnus;* anyhow it cannot belong to the same species as that which Professor M'Coy describes and figures in 1855, under the denomination of *Camarophoria laticliva*.[1]

In 1843 Professor De Koninck had united *R. pugnus*, and one or two more species, under the single specific denomination of *Ter. acuminata;* but at p. 664 of his work on 'Belgian Carboniferous Fossils,' he has corrected the oversight, and referred figs. 3, 3 *h* and *i*, of his pl. xviii, to the shell we are now describing.

Loc. Martin states that the species is common in Carboniferous limestone at Castleton, Hope, and Little-Longstone, in Derbyshire. Gilbertson's largest examples appear to have been obtained at Linton, in the Craven district. It is also abundant at Whitewell, Widgill, and Twiston, all situated at a few miles from Clithero. It does not appear to be rare at Kendal, nor in the Isle of Man, &c.

In Scotland it occurs in several localities of the Lanarkshire and Stirlingshire Carboniferous basins, such as at Hill-head, Campsie, &c. In Ireland, Mr. Kelly mentions Ardagh, Millecent, Little Island, &c.

It is also a common fossil in many foreign Carboniferous districts; it occurs at Visé, in Belgium, as well as on the oriental side of the Oural, to the east of Miash, &c.

RHYNCHONELLA PLEURODON, *Phillips*, Sp. Pl. XXIII, figs. 1—15, 16—22?

TEREBRATULA MANTIÆ, *Sowerby*. Min. Con., tab. cclxxvii, fig. 1, May, 1821.
— PLEURODON, *Phillips*. Geology of Yorkshire, vol. ii, p. 222, pl. xii, figs. 25—30 (but not 16), 1836.
— VENTILABRUM, Ibid., p. 223, pl. xii, figs. 36, 38, and 39, 1836.
— PENTATOMA, *De Koninck*. Animaux fossiles de la Belgique, p. 289, pl. xix, fig. 2 (not *T. pentatoma*, Fischer) in p. 664; this mistaken identification is corrected to *T. pleurodon*, of Phillips, 1843, and 1851.
ATRYPA PLEURODON, *M'Coy*. Synopsis of the Carb. Foss. of Ireland, p. 155, 1844.
— TRIPLEX, *M'Coy*. Ibid., p. 157, pl. xxii, fig. 17, 1844.
TEREBRATULA PLEURODON, *De Verneuil* and *Keyserling*. Geol. of Russia, vol. ii, p. 79, pl. x, fig. 2, 1845.
— DAVREUXIANA, *De Koninck*. Animaux foss. de la Belgique, p. 664, 1851.
HEMITHYRIS PLEURODON, *M'Coy*. British Pal. Fossils, p. 382 and 441, 1855.

Spec. Char. Transversely oval, rarely longer than wide, very variable in shape;

[1] 'British Palæozoic Fossils,' p. 444, pl. iii D, figs. 20, 21. I have reproduced in my plate the author's figures, published in 1844 and 1855, so as to enable the reader to form his own opinion upon the subject.

valves more or less convex, sometimes very gibbous, beak moderately produced, incurved, and exhibiting a small circular foramen under its angular extremity, which is surrounded and slightly separated from the hinge-line by a deltidium; medial fold large, almost square, and most elevated close to the front, when it is suddenly deflected, so as to meet the corresponding margin of the opposite valve; sinus in ventral valve of moderate depth; ribs numerous and angular, extending over the whole surface, and numbering from ten to about twenty-four in each valve, of which three to nine compose the fold, and two to eight the sinus; but five on the fold and four in the sinus is the general number. The plaits that cover the lateral portions of the dorsal valve are very much curved, while those of the ventral one are nearly straight, with their extremities bent upwards. The ribs are longitudinally grooved along their median portion to some distance from the margin. Dimensions very variable; three examples have measured:

Length 10, width 14, depth 11 lines.
„ 9, „ 13, „ 10 „
„ $6\frac{1}{2}$, „ 11, „ 5 „

Obs. This Rhynchonella is very abundant in the Carboniferous rocks, but varies so much in shape, according to age and specimen, that several so termed species have evidently been manufactured out of what I conceive to be mere differences in shape, race, and even malformation of a single species.

R. pleurodon does not appear to have ever attained very large proportions, and is distinguishable from *R. pugnus*, *R. acuminata*, and *R. reniformis*, by the angular ribs which cover the entire surface of its valves. When young, with dimensions of from two, three, and sometimes more lines in length, both valves are at times much compressed, the fold and sinus being but little elevated or depressed beyond the regular convexity of the valves, a small longitudinal depression extending likewise along the median portion of the umbone of the dorsal valve. In the fry the shell is at times somewhat triangular, the width being equal to the length, but with growth the shape becomes more transverse, and rapidly increases in depth or convexity, the fold and sinus assuming likewise their characteristic appearance. Many young specimens of undoubted *R. pleurodon* possess but three ribs on the mesial fold, and two in the sinus, but in the larger number of full-grown shells five were prevalent, although we sometimes pick up specimens with as many as from six to nine ribs on the fold; but these are exceptions, and of much less common occurrence.

It may now be desirable to examine what are those so-termed species which I have been tempted to consider as simple variations in shape or synonyms of *R. pleurodon*.

First.—Rh. (*Terebratula*) *Mantiæ*, Sowerby, pl. xxiii, figs. 15, 15 *a*, *b*, *c* ('Min. Con.,' tab. cclxxvii, fig. 1, May, 1821).

Sowerby founded his *T. Mantiæ* from the inspection of a single specimen, said to have been collected in Ireland by a Mrs. Mant, but unfortunately the figure published in the 'Mineral Conchology' does not convey an accurate idea of the shell, and I

am not therefore surprised that palæontologists should have felt embarrassed, and have identified with the imperfect illustration shells of an entirely different character. Having obtained the loan of the original example, through the kindness of its possessor, Mr. J. de C. Sowerby, I have been able to study and illustrate its characters with sufficient care. It is always very hazardous to establish species from the inspection of a single specimen, and especially among so variable a group of shells as that of the *Rhynchonellæ*. Sowerby's *T. Mantiæ* appears to me to be nothing more than an accidentally elongated malformation of *R. pleurodon*, wherein the mesial fold (composed of five ribs) had become unsymmetrical, from being twisted more to one side than to the other, an occurrence not uncommon to many species of *Rhnychonella*, which in their normal state have the fold and sinus in the middle. I purposely avoided referring, in the list of references, to the works of those authors who have alluded to *T. Mantiæ*, as they were evidently unacquainted with the characters of Sowerby's shell, which measures nine lines in length, eight in width, and six in depth. Notwithstanding the priority of date of *R. Mantiæ* over *R. pleurodon*, I believe all palæontologists will prefer retaining Phillips's denomination for the species; especially so as Sowerby's one has unfortunately been the cause of so much misapprehension, being founded on a malformation. At page 146 of the first volume of D'Orbigny's 'Prodrome,' *T. proava* of Phillips is considered a synonym of *T. Mantiæ*, but I believe the French author's guess to be incorrect.

In 1843, Professor De Koninck described and figured a totally different shell under the name of *T. Mantiæ*, and to which he had likewise added *T. radialis* of Phillips, as synonym, but the distinguished Belgian author has since then recognised his mistake. At page 437 of M'Coy's work on 'British Palæozoic Fossils,' a shell is described under the generic and specific appellation of *Spirigerina* (?) *Mantiæ*, Sow., sp., but as no illustration is appended, all that can be said is, that the shell so described cannot have belonged to Sowerby's species, because *T. Mantiæ* possesses all the exterior appearances and characters of a true *Rhynchonella*, and none of those of a *Spirigerina*, nor does it present "a large, high, flat, cardinal area," or any appearance of the punctured shell-tissue, described in the work above quoted. It is, therefore, certain that Professor M'Coy must have had some other species before him while drawing up his description.

Secondly.—Rhynchonella (Ter.) *ventilabrum*, Phillips (pl. xxiii, figs. 13, 14), ('Geology of Yorkshire,' vol. ii, p. 223, pl. xii, figs. 36, 38, 39, 1836).

Professor Phillips states that he "is not certain whether his species be distinct from *T. sulcirostris*, that it has no mesial elevation, the ribs rounded, and vanishing towards the margin." In Pl. XXIII, I have reproduced the author's figures, but feel but little doubt while placing *R. ventilabrum* among the variations of form, or synonyms of *R. pleurodon*, for the typical example (fig. 13) exactly resembles certain specimens of the last-named species, in which the mesial fold is indistinctly marked; in fig. 14 it may, however, be clearly perceived. *R. sulcirostris* has been with some doubt considered a synonym of *R. pugnus*, from the shortness of its lateral ribs, and I regret not having been

able to discover the original examples in the Gilbertsonian collection ; the conclusions here recorded are therefore based upon an examination of the figure only, for the few words of description which accompany it do not materially assist.

Thirdly.—Rhynchonella Davreuxiana, De Koninck (Pl. XXIII, figs. 18—20), (De Koninck, 'Animaux Fossiles qui se trouvent dans le terrain Carbonifere de la Belgique.' Supplement, p. 664, 1851).

Notwithstanding the superior authority of my distinguished friend, Professor De Koninck, I cannot help feeling impressed with the idea that the form above named is only a small thick variety, or local race of *R. pleurodon* (?). None of the specimens I have been able to examine (and which were all obtained at Gilling, by Mr. E. Wood) did exceed $3\frac{1}{2}$ lines in length, 4 in width, and $2\frac{1}{2}$ in depth. In the larger number of specimens, three and four ribs were prevalent upon the fold, but in some others five could be counted; the ribs generally extend from the beak and umbone to the margin, but sometimes, as was the case with certain young shells of *R. pleurodon*, the ribs became obsolete close to the extremity of the beaks. Should my present views relative to this shell be considered erroneous, palæontologists will do right in adopting Professor De Koninck's specific denomination, and I may observe that the specimens of *R. Davreuxiana* figured in my plate, were so determined by the Belgian author himself.

Fourthly.—Rhynchonella triplex, M'Coy, sp. (pl. xxiii, figs. 16—18) ; *Atrypa triplex*, M'Coy, 'Synopsis of the Carb. Foss. of Ireland,' p. 157 (pl. xxii, fig. 17, 1844).

Professor M'Coy describes his shell as "transversely oval, gibbous; beaks very small, pointed; surface with nine short, angular ribs, which reach but half-way to the beak; front elevated with three of the ridges; the three ridges on each side slightly larger than the mesial ones. This pretty little shell is remarkable for its three equal lobes, of three ridges each; it is distinguished from the *A. raricosta*, Phillips, by the ridges extending only half-way to the beaks on the ventral valve, and its very small size. Length, two and a half lines; width, three lines." In our Plate XXIII, fig. 17 is copied from the 'Synopsis.'

No locality is given, but Mr. Kelly supplies the deficiency, by informing us that the shell was found in yellow or reddish sandstone, forming the base of the Carboniferous system, at Kildress, in Tyrone ; and he kindly furnished me with specimens of the sandstone, which I found to contain, in addition to casts of *Spiriferina octoplicata*, *Athyris ambigua*, *St. crenistria*, and *Rh. pleurodon*, many examples of M'Coy's *Atrypa triplex;* and although some few of the specimens of the last did present exactly the characters described by the author, still it was easy to perceive that this little *Rhynchonella* varied as well as all other species of the genus in the number of its ribs; and on the same slab could be seen specimens which connected by gradual passages *R. triplex* to *R. pleurodon*, proper, and of which I believe it to be the fry. All the fossils above enumerated as occurring in the sandstone of Kildress are in the state of casts, and the ribs in some of the examples referable to *R. triplex*, extend much further along the surface of the valves

than was indicated by Professor M'Coy. We have already had occasion to remark that in certain young shells of *R. pleurodon* a small portion of the beak and umbone was sometimes smooth, as is seen in the small *R. triplex* from Kildress. In the shales, on the upper portion of the Carboniferous limestone at Settle, in the parish of Carluke, and elsewhere, we find small specimens of a *Rhynchonella* with nine ribs, and which agree with the characters assigned by M'Coy to his species; but here also we observe that they pass, by insensible gradation, into *R. pleurodon*, and in some the sinus and fold is unsymmetrical or twisted, as was the case with the shell upon which Sowerby founded his *Terebratula Mantiæ*.

The specimen represented and described by General Portlock in pl. xxxviii, fig. 4, of his excellent 'Report on the Geology of Londonderry, Tyrone, and Fermanagh,' as *Terebratula* (?) *ferita*, (?), V. Buch, and which was found also in the red or yellow sandstone of Kildress, is evidently a young example of *R. pleurodon;* Von Buch's species being quite distinct, and belonging to another genus (*Retzia*).

It is well known, as I have already so often had occasion to remark, that the number of ribs varies exceedingly according to age and specimen in almost every known species of *Rhynchonella*, so that no definite number can be made use of as an unvariable character, and no name given to a species should be founded upon the number of ribs possessed by a single specimen.

Loc. In England *R. pleurodon* is abundant in the Carboniferous limestones and shales at Bolland, Settle, Kirby Lonsdale, Orton, and in several other Yorkshire and Derbyshire localities, &c. In Scotland it is found in similar beds in various localities in Lanarkshire, near Carluke, Campsie, also in Westlothian. In Ireland it occurs in the red sandstone of Kildress, and in the limestone and shales of other localities. It is also a common fossil in other Carboniferous districts of the world. At Visé, in Belgium, by Professor De Koninck. In Russia it is described from Archangleskoi, Cosatchi-datchi, Sterlitamak, &c. In Australia it has been recently discovered in beds of the Carboniferous period at Bundaba, Port Stephen; and is common in the Carboniferous rocks of America, &c.

RHYNCHONELLA FLEXISTRIA, *Phillips* (sp.) Pl. XXIV, figs. 1—8.

TEREBRATULA FLEXISTRIA, *Phillips*. Geol. York., vol. ii, p. 222, pl. xii, figs, 33 and 34, 1836.
— TUMIDA. Ibid., fig. 35.
HEMITHYRIS HETEROPLYCHA, *M'Coy*. Annals and Mag. of Nat. Hist., 2d series, vol. x, and British Palæozoic Fossils, p. 440, pl. iii D, fig. 19, 1855.
— FLEXISTRIA. British Palæozoic Fossils, p. 439.

Spec. Char. Shell oblate, or transversely ovate; dorsal valve more convex than the

ventral one; beak small, much incurved, sometimes inconspicuous, on account of the gibbosity of the dorsal valve; sinus moderately deep, fold more or less prominent. The surface of each valve is ornamented by from fifteen to forty ribs, those on the fold and sinus being generally larger and wider than those that cover the lateral portions of the valves; the ribs also become more numerous by intercalation or bifurcation at various distances from the beak and umbone, and especially so on the lateral portions of the valves, where they are generally much curved and smaller. Dimensions very variable; three specimens measured—

Length 10, width 13, depth 8 lines.
„ 8, „ 10, „ 7 „
„ 7, „ 9, „ 6 „

Obs. After a long and minute examination of the typical and many other examples of *Terebratula flexistria* and *T. tumida* (Phillips),[1] as well as of *Hemithyris heteroplycha* (M'Coy), I arrived at the conclusion that they were all variations in shape of a single species, for which the designation of *flexistria* has been retained. At p. 222 of the 'Geology of Yorkshire' (vol. ii), Professor Phillips describes his two shells with the following words: "*Terebratula flexistria.* Oblate, depressed, mesial elevation rounded; lower valve smaller, flatter, with inconspicuous beak; many obtuse striæ, *much curved on the sides.*"

"*Terebratula tumida.* Oblate, tumid, lower valve flatter, with inconspicuous beak; striæ strong and rounded on the middle, smaller and *curved on the sides.*" Both are stated to be from Bolland, and I have reproduced in Pl. XXIV the author's original figures (1 and 7), also those given by Professor M'Coy of his *H. heteroplycha* (fig. 5). Every intermediate passage or gradation of shape and character can be found, whereby the three shells above mentioned are intimately connected; in some the ribs on the fold and sinus are few in number, large, simple, and varying from three to six; those on the lateral portions of the valves being smaller and almost entirely simple; while in other examples, some or all the ribs have bifurcated or augmented by the means of intercalations at various distances from the beak and umbone, the relative disproportion in size of the ribs on the fold and lateral portions of the valves not being so apparent. The beak likewise is inconspicuous in some specimens, while in others it is slightly produced above the umbone of the dorsal valve. In Pl. XXIV, I have endeavoured to represent all these appearances or variations of detail, to which the reader can refer. The umbone varies also much in degree of convexity, being uniformly rounded in some specimens, while there exists in others a slight median depression.

Rh. flexistria and its varieties may be distinguished from *Rh. pleurodon* (to which some examples approach) by their general shape, disposition, and character of their dichotomising

[1] The original examples of Professor Phillips's species form part of the Gilbertsonian Collection in the British Museum. Professor M'Coy's *H. heteroplycha* is preserved in the Geological Museum at Cambridge.

ribs, which do not appear to have been grooved along the middle, as is the case with those of the last-named species.

Loc. *R. flexistria* is not a very common species; it occurs in the Carboniferous limestone of Bolland, Clitheroe, and in several Derbyshire localities, &c. In Ireland, Mr. Kelly mentions Millecent, Rahoran, and Knockninny. I am not acquainted with any Scottish specimen, nor is it known to me from any Continental locality, although it is no doubt to be found in several.

RHYNCHONELLA ANGULATA, *Linnæus* (sp.) Pl. XIX, figs. 11—16.

ANOMIA ANGULATA, *Linnæus*. Systema Naturæ, i, pars ii, p. 1154, 1767.
TEREBRATULA EXCAVATA, *Phillips*. Geol. Yorks., vol. ii, p. 223, pl. xii, fig. 24, 1836.
— ANGULATA, *De Koninck* Animaux foss. de la Belgique, vol. i, p. 284, pl. xix, fig. 1, 1843.
RHYNCHONELLA ANGULATA, *D'Orbigny*. Prodrome, vol. i, p. 146.[1]
HEMITHYRIS ANGULATA, *M'Coy*. British Palæozoic Fossils, p. 439, 1855.
ANOMIA ANGULATA, *Hanley*. Ipsa Linnæi Conchylia, p. 133, 1855.

Spec. Char. Elongated, sub-trigonal or cuneiform, rarely as wide or wider than long, the greatest breadth at a short distance from the front; valves sometimes much flattened, but assuming every degree of convexity, and even gibbosity. The lateral portions of the beaks in both valves are much depressed, forming large, broad, flattened spaces, which extend to upwards of half the length of the shell; the beak of the ventral valve is moderately produced, tapering to a point, nearly straight, or but feebly incurved; foramen small, margined by a deltidium. The dorsal valve is convex and sharply incurved at the umbone, almost straight towards the front, the lateral portions of the valve sloping rapidly on either side. The surface is smooth close to the umbone, but soon becomes ornamented by from six to nine large angular plaits, of which two, three, or four compose the mesial fold, while one, two, or three strongly curved plaits occupy each side of the lateral portions of the valve. The ventral valve, when viewed in profile, presents a very convex curve from the beak to the extremity of the sinus, this last being in general rather shallow, and composed of one, two, or three angular ribs. Measurements taken from three individuals have presented—

Length 12, width $9\frac{1}{2}$, depth 7 lines.
„ 10, „ 6 „ $7\frac{1}{2}$ „
„ 10, „ 11 „ 8 „

Obs. This remarkable but variable shell may always be distinguished from other

[1] This appears to be the only species belonging to the genus *Rhynchonella* D'Orbigny would admit in the Carboniferous period, all the other species of this genus are placed by him in the genus *Atrypa*!

species of *Rhynchonella* found in the Carboniferous system, by the compression or excavation of the lateral portions of its beaks, which give to the shell that peculiar sub-trigonal or cuneiform appearance which no doubt prompted the specific designation of *angulata*, and at a later period that of *excavata*, by Professor Phillips. The ribs are likewise characteristic of the species, but not to such an extent as the lateral compressions of the beaks.

Rh. angulata bears some resemblance to certain individuals of the Silurian *Rh. cuneata* of Dalman, but from which it may be distinguished by a difference in the character of its ribs. *R. lateralis* of Sowerby has been (by some authors) added to the synonyms of *angulata;* but if we are to judge from the description and figure published in the 'Mineral Conchology' (tab. lxxxiii, fig. 1), the identification must be looked upon as uncertain, for the Sowerby representation does not exhibit those flattened or depressed spaces on either side of the beaks which are observable in the Linnean species; and this view is further strengthened by Sowerby's own remark, that "*Ter. lateralis* is probably a variety of *R. pugnus*, although it has only three plaits" ('M. C.,' vol. v, p. 155).[1] In any case, whether *R. lateralis* be or not a synonym of the Linnean species, or a variety of *R. pugnus*, the name will require to be erased from the nomenclature, on account of Linnæus's species, as well as that of Martin, claiming priority of date over the Sowerby one. I must also differ with the statement made by Professor De Koninck, at p. 285 of his excellent work on the 'Carboniferous Fossils of Belgium,' that Bruguière has figured the species in the 'Encyclopédie méthodique,' or that it is the same as the one to which Lamarck gave the name of *T. plicata* at a later period; for although Bruguière's representation ('Ency. méth., pl. ccxliii, fig. 11, and pl. ccxli, fig. 1, 1789) might bear a somewhat obscure resemblance to certain examples of *R. angulata*, it represents a much larger shell, with a beak strongly incurved, and very different to that of Linnæus. Besides, I believe that Bruguière's figure represents a liasic shell found in the north of Italy, and the same as that termed *Terebratula plicata* by Lamarck, at p. 254 of the sixth vol. of his work, and wherein he refers to the figure of Bruguière above quoted. When writing my report on Lamarck's Fossil Terebratulæ, which was published in the fifth vol. of the 'Annals and Mag. of Natural History' (pl. xix, fig. 39, 1850), I was able to draw the original specimen upon which the author had founded his species. I am therefore

[1] To my regret the original example could no longer be found in the Sowerby collection, but I have reproduced the original representation (Pl. xxv, fig. 14), and here append the description taken from p. 189 of vol. i of the 'Mineral Conchology,' so that every one may form his own opinion.

"*Spec. Char.* Oval, broader than long, gibbous; middle of the front much elevated, with three deep, but short plaits; sides with two plaits each, much below the middle.

"The three plaits in the middle of the imperforated valve, though not continued far into the shell, produce three very deep angular notches, which are filled by as many sharp teeth on the edge of the other valve, which is not so much plaited, and is altogether flatter. The length of the edge between the central plaits and the lateral ones is remarkable. This is found in the limestone rock near Dublin, and in the black rock near Cork. The stone is generally a compact darkish marble, fetid when scraped."

acquainted with but a single certain synonym, that of *excavata*, published by Professor Phillips in 1836.

The original example of *R. angulata* is still preserved in the Linnean collection, where it has been compared by myself, as well as by several of our London Palæontologists. I am also of the opinion expressed by the late Mr. Sharpe, that *R. angulata*, of Sowerby, found in the Jurassic strata of England, is specifically distinct from that of Linnæus, and must receive another denomination.

Loc. *R. angulata* does not appear to be a very abundant fossil; it is found in the Lower Scar limestone of Yorkshire and of the Isle of Man. In Ireland it is stated by Mr. Kelly to occur at Ardagh, and abundantly at Ardelogh; but I am not acquainted with any Scottish example. On the Continent it has been collected by Professor De Koninck from the Carboniferous limestone of Visé, in Belgium.

RHYNCHONELLA (?) TRILATERA, *De Koninck.* Pl. XXIV, figs. 23—26.

TEREBRATULA TRILATERA, *De Koninck.* Animaux fossiles de la Belgique, p. 292, pl. xix, fig. 7, 1843.
RHYNCHONELLA TRILATERA, *Morris.* Catalogue of British Fossils, 2d ed., p. 148, 1854.

Spec. Char. Shell sub-triangular or sub-quadrate, with the angles rounded; valves almost equally deep, convex, and flattened along the middle; a slight median depression or groove, originating at the extremity of the beaks, in either valve, extends at times to the frontal margin. The beak of the ventral valve is acute, very small, and generally closely adpressed to the umbone of the opposite one; the lateral portions of the beaks in either valve are flattened or compressed, while the frontal margin is nearly straight, from the total absence of all sinus or fold. From sixteen to eighteen angular ribs ornament the surface of either valve, while the five or six central are generally much larger than lateral ones. Interior unknown. Two examples measured—

Length $4\frac{1}{2}$, width 5, depth 3 lines.
„ 5, „ 5, „ $2\frac{1}{2}$ „

Obs. This remarkable species, of which no British specimen has till now been figured, does not appear to have ever attained much larger proportions than those above given, and is easily distinguishable from its congeners by the peculiar shape and character of its shell. It varies somewhat in the degree of convexity or flatness of its valves, and the median groove or depression is more or less apparent. The dorsal valve is more often flatter than the ventral one; the ribs also either diminishing regularly in width from the centre, or having the middle ones (comparatively) much larger than those that cover the lateral portions of the valves.

None of the interior characters being at present known, the shell is provisionally

located with *Rhynchonella*, whence it may be hereafter removed, should the necessity for so doing become apparent. Seven British examples alone have come under my notice, and of these four will be found represented in our plate. Three good specimens from the Carboniferous limestone of Alstonfield, in Derbyshire, may be seen in the Museum of Practical Geology; while the remaining four, which form part of the Gilbertsonian Collection in the British Museum, were probably derived from a different locality, as they are more triangular and flattened than the Derbyshire examples above mentioned. Professor De Koninck, who first described and illustrated the species, mentions that it is among the rarer species from the Carboniferous limestone of Visé, in Belgium.

Doubtful Species.

A. Rhynchonella (?) nana, *M'Coy*. Pl. XXV, fig. 15.

Atrypa nana, *M'Coy*. Synopsis of the Characters of the Carboniferous Fossils of Ireland, p. 155, pl. xxii, fig. 19, 1844.

"*Spec. Char.* Orbicular, or slightly ovate, compressed, beak pointed; surface radiated with about ten straight, equal, obscurely angular ridges, none of which reach the beak. This little species resembles *T. radialis* in form, but is much flatter, and has considerably fewer, larger, and more angular ribs, all of which disappear before reaching the beak, as in the *A. subdentata* and *rotunda*, Sow., from both of which it is distinct by its greater flatness, and more numerous radiating ridges; it is also much smaller than any of those shells. Length two lines, width two lines." (M'Coy's 'Synopsis,' p. 155.)

Obs. As all the endeavours I have made to procure the sight of a specimen of this shell have proved unsuccessful, the only thing I can do is to reproduce the author's description and figures. These are not, however, sufficiently detailed or precise to permit of any comment as to the probable generic or specific value of the species; and it is even possible and probable that *A. nana* may be but the fry or young of some other of the described species, such as of *R. pleurodon* (?), of which some young examples of similar dimensions would closely resemble. The species cannot, therefore, be admitted upon such vague and uncertain grounds, and is only here appended for the sake of reference.

Mr. Kelly informs me that the *A. nana* is common at Rahoran, in the county of Tyrone, and that it occurs in a Calciferous slate, which is situated between the limestone and a reddish sandstone, which forms the basis of the Carboniferous system in Ireland. It is to be regretted that of a shell stated "so common," not a specimen could be procured for the present monograph.

B. Rhynchonella (?) semisulcata, *M'Coy*. Pl. XXV, fig. 13.

Atrypa semisulcata, *M'Coy*. Synopsis of the Characters of the Carboniferous Fossils of Ireland, p. 157, pl. xxii, fig. 15, 1844.

"*Spec. Char.* Orbicular, depressed; beak small; mesial fold broad, flat, with about five strong, rounded, radiating ridges, continued to the beak; sides smooth, or very finely striated longitudinally. This species is very remarkable, from the coarsely ridged mesial fold, and nearly smooth sides. Length seven lines, width eight lines." (M'Coy.)

Obs. From not having been able to procure determinable specimens of this shell, I cannot speak as to its generic or specific claims. Through the kindness of Sir R. Griffith I have been able to examine the original example from which M'Coy's lower figure was drawn; but this is simply a flattened, obscure impression on a slab of what Sir R. Griffith calls "black calp slate," from Walterstown Skreen, and not very correctly represented either in the plate. Mr. Kelly informs me that the shell has been found in what he considers to be "coal shales," at Culkagh, Ballintree, and Walterstown, in Ireland.

C. Rhynchonella or Camarophoria (?) proava, *Phillips*. Pl. XXV, fig. 10.

Terebratula proava, *Phillips*. Geology of Yorkshire, vol. ii, p. 223, pl. xii, fig. 37, 1836.

"*Spec. Char.* Beak produced; radiations obtuse; mesial fold square. Strongly allied to the Oolitic species *T. obsoleta* and *T. socialis*, &c." (Phillips.) (Carboniferous limestone) Bolland.

Obs. The original specimen may be seen at the British Museum, it forms part of the Gilbertsonian Collection, but several other shells which do not belong to the species are evidently attached to the same tablet.

The specimen on which Professor Phillips created his species is of an elongated oval shape, with nineteen or twenty small ribs on each valve, but which become obsolete at the beaks; the mesial fold is of but small elevation above the general convexity of the valve, and is ornamented by five ribs; the sinus is shallow. Length eight, breadth seven, depth five lines.

Notwithstanding the examination I was able to make of the original specimen, I felt uncertain as to its being a good species. It might possibly be a *Camarophoria*, and perhaps even an abnormal shape of *Camarophoria crumena* (?). Until more material shall have been procured, it will be safer to consider *T. proava* as one of the doubtful or uncertain species.

D. Rhynchonella (?) gregaria, *M'Coy*. Pl. XV, figs. 27, 28.

Atrypa gregaria, *M'Coy*. Synopsis of the Carboniferous Fossils of Ireland, p. 153, pl. xxii, fig. 18, 1844. (Not *Atrypa gregaria*, M'Coy, British Palæozoic Fossils, p. 435, tab. iii D, fig. 20, 1855).

"*Spec. Char.* Trigonal; beak of the dorsal valve (*ventral*, Owen) very large, produced, incurved; dorsal valve flattened; sides abruptly rounded; a very wide, but shallow, mesial depression, slightly produced in front; ventral valve (*dorsal*, Owen) an equilateral triangle; all the angles rounded very convex; front margin raised to a broad sinus; surface smooth." "This curious species is very remarkable in form, wholly unlike any of the other Palæozoic species, approaching in size and shape to the *Terebratula lineolata*, Phil., of the Speeton Clay; it is the only true *Atrypa* I know of, resembling in this respect several of the *Terebratulæ* of the more recent formations. Length seven lines, width six lines, depth three lines and a half." (M'Coy, 'Synopsis,' p. 153.)

Obs. Of this shell I am acquainted with but the single ventral valve, that was kindly lent to me by Sir R. Griffith, and which I found to agree with the same valve that is figured by Professor M'Coy in his 'Synopsis;' but all my efforts to procure a bivalve example or the dorsal valve have proved unsuccessful. On such insufficient material I could not venture to describe the species, and have, therefore, reproduced that given by Professor M'Coy in 1844; for I cannot admit that the shell subsequently published as *Athyris gregaria* in the work on 'British Palæozoic Fossils' by the same author, could belong to the same species as that of the 'Synopsis.'[1] I am also uncertain as to its genus, and although placed in Pl. XV among the *Athyrises* with a point of doubt, I now prefer to locate it provisionally among the *Rhynchonellæ*, on the simple authority of M'Coy's figures, which bear more resemblance to a *Rhynchonella* than to an *Athyris*. In my plate I have reproduced Professor M'Coy's three original figures, and have added a drawing of the ventral valve that was kindly lent me by Sir R. Griffith.

Mr. Kelly mentions that the species was derived from the Calcareous slate of Ballinglen, Kilbride, and White River, in Ireland; but the specimen lent me by Sir R. Griffith had all the appearance of having been taken from the Carboniferous limestone. I am not acquainted with any English or Scotch specimens.

[1] It belongs to Professor Hall's *Athyris subtilita*.

CAMAROPHORIA CRUMENA, *Martin* (sp). Pl. XXV, figs. 3—9.

CONCHYLIOLITHUS ANOMITES CRUMENA, *Martin*. Petrificata Derbiensia, pl. xxxvi, fig. 4, 1809.

TEREBRATULA SCHLOTHEIMI, *Von Buch*. Ueber Terebratula, p. 39, pl. ii, fig. 32, 1834.

CAMAROPHORIA SCHLOTHEIMI, *King*. A Monograph of the Permian Fossils of England, p. 118, pl. vii, figs. 10—21, 1850. Dav. Mon. of British Permian Brachiopoda, part iv, p. 25, pl. ii, figs. 16—27, 1857, &c.

Spec. Char. Shell obscurely rhomboidal or deltoid, with marginal expansions; generally wider than long; greatest breadth towards the anterior portion of the shell. Beak of ventral valve small, moderately prominent, and incurved; foramen minute; sinus varying in depth and width according to age and specimen, flattened along the middle. Dorsal valve more convex than the opposite one, arched in profile; marginal expansions slightly bent upwards; the mesial fold commences at a short distance from the umbone, and varies in width and elevation according to the number of ribs which cover its surface; the lateral portions of the valve slope rapidly downwards. The ribs which ornament the valves generally commence at about the middle of the shell, and extend to the margin; in number they vary from thirteen to twenty-four in each valve, of which from three to six occupy the fold, while two to five ornament the sinus. The ribs on the lateral portions of the shell are sometimes strongly marked, while at other times they are but indistinctly defined. A large specimen measured, without its marginal expansions—length nine, breadth eleven and a half, depth six lines; but the dimensions were generally smaller.

Obs. Several palæontologists have alluded to the presence of *Camarophoria Schlotheimi* in the rocks of the Carboniferous period; thus M. de Verneuil and Count Keyserling state, in their great work on Russia (1845), that the Permian species was found by them in the Carboniferous limestone of Mount Chéractau, near Sterlitamack; at Sarana, on the Ufa; and at Cosatchi Datchi, to the east of Miask (Oural). In the second edition of Morris's 'Catalogue,' *C. Schlotheimi* is also recorded from the Carboniferous limestone of Derbyshire. At p. 119 of his 'Monograph of English Permian Fossils,' Professor King states that "*Camarophoria Schlotheimi* closely resembles the *Cam. crumena* of Martin, which appears only to differ from the former in being narrower and more accuminated behind; occasionally, however, a variety of the present species occurs, which can scarcely be distinguished from *C. crumena;* in short, both species apparently merge into each other so completely, that many would be inclined to consider them as specifically inseparable." In a note at the bottom of the page the same author has added, that having examined (what I believe he erroneously takes to be) Martin's original specimen of *Crumena*, in Mr. J. de C. Sowerby's Collection, he found that it belonged to the genus *Camarophoria;* and moreover that a tablet in the Gilbertsonian

Collection in the British Museum (erroneously labelled *T. plicatella*, Dalman[1]), and mounting nine specimens, with three to five ribs in the sinus, are undoubtedly *Camarophorias*, and that his notes state that they are identical with *C. Schlotheimi*. With all this evidence before me, I considered it necessary to ascertain what was really the *Anomites crumena* of Martin, and whether the Permian *C. Schlotheimi* does really occur in the Carboniferous limestone; and it was not until after much comparison and investigation that I became convinced that not only were the Carboniferous specimens alluded to by Professor King and others specifically identical with the Permian *Camarophoria*, but that it was impossible to distinguish the last from *A. crumena* of Martin.[2]

The term *Schlotheimi*, given to the species in 1834, by Baron V. Buch, must, therefore (much to my regret), be added to the synonyms of Martin's *A. crumena*, as we cannot preserve two names for the same species. *C. crumena* partakes of the general misfortune (as far as palæontologists are concerned) of presenting endless variations in shape and number of ribs; thus we find specimens with three, four, five, and six ribs on the mesial fold, and those on the lateral portions of the shell vary also in number, width, and degree of projection. In many examples the posterior portion of the shell is almost smooth, the ribs occupying only the anterior half; but in other specimens the ribs commence to be visible from the extremity of the beak and umbone, and extend uninterruptedly to the margin. Martin's figure portrays one of the shapes presented by this species, and I have

[1] Fig. 9 represents the largest specimen in question.

[2] Mr. Kirkby states that after having carefully examined the specimens and figures of *Camarophoria crumena* I sent him, with some hundreds of *C. Schlotheimi*, he could not find a single character distinguishing the one from the other. In both the series of specimens we have the same variation in length and width, the same difference in the elevation of the mesial fold, and the same latitude in the number of ribs ornamenting that fold; and that he should certainly consider both the Carboniferous and Permian specimens to belong to one species; that had he found the Carboniferous specimen in a Permian locality, and especially in the compact limestone, he would have referred them to *C. Schlotheimi*, withou any doubt whatever.

As *C. crumena* is a rather important species, I have reproduced Martin's original figure (Pl. XXV, fig. 3), and will now transcribe the description he has given of his specimen:

"*Conchyliolithus anomites crumena*, scrotiformis, sulcis longitudinalibus subobsolescentibus, margine sino 3-plicato s.p.

"A fossil shell. The original an *anomia*. Perforate, valves convex, purse-like; or bellied and gradually increasing in size, from the beaks to the opposite extremity. Hinge curved, compact. Foramen oblong, very minute (rarely visible), situate under the apex of the larger beak, which is sharp-pointed and incumbent. The surface of the shell longitudinally furrowed; the furrows few, not more than ten or twelve, deep at the margin, but gradually becoming indistinct as they approach the beaks. The three central furrows form, in the smaller valve, a convex wave, answered in the other valve by a concave one; both terminating in a deep, three-plaited sinus at the margin. *Loc.* Winster."

The representation by Sowerby, tab. lxxxiii, fig. 3, of the 'Mineral Conchology,' does not convey an accurate idea of the species under description; and I do not believe that Martin's specimen could have been made use of for that illustration, as supposed by Professor King. Some of his figures, likewise, appear to have been taken from a Jurassic Rhynchonella.

endeavoured to represent some of the others. The marginal expansions are rarely obtained, on account of the hardness of the limestone matrix; but small portions were distinctly visible on several of the specimens that came under my observation, and I must refer the reader to p. 26, and Pl. II, of my 'Permian Monograph,' wherein he will find perfect exteriors and interiors of the species both represented and described. None of the Carboniferous specimens showed perfectly the interior arrangement, but the median septum and conjoined dental or rostral plates of the ventral valve, as well as portions of the septum which supports the spatula-shaped process in the dorsal one, could be distinctly seen in several examples.

Loc. Martin mentions that his shell was not common at Winster and Cromford, but it does not appear to be very rare in the Lower Scar limestone of Settle, in Yorkshire, whence many examples have been obtained by Mr. Burrow; and it is probable that Gilbertson's specimens in the British Museum were derived from some locality in the same county. It has been found also in the Carboniferous limestone of Dovedale, in Derbyshire, and in West Lothian, Scotland, by the late Dr. Fleming. Professor de Koninck has obtained specimens exactly similar to our own in the Carboniferous limestone of Visé, near Liège, in Belgium; and several Russian localities have been already mentioned.

CAMAROPHORIA GLOBULINA, *Phillips*. Pl. XXIV, figs. 9—22.

TEREBRATULA GLOBULINA, *Phillips*. Encyl. Met. Geol., vol. iv, pl. iii, fig. 3, 1834.
— RHOMBOIDEA, *Phillips*. Geol. York., vol. ii, p. 222, pl. xii, figs. 18—20, 1836.
— SEMINULA, *Phillips*. Ibid., figs. 21—23.
RHYNCHONELLA RHOMBOIDEA, *Morris*. A Catalogue of British Fossils, p. 147, 1854.
HEMITHYRIS LONGA, *M'Coy*. British Pal. Foss., p. 440, pl. iii D, fig. 24, 1855.
CAMAROPHORIA GLOBULINA, *Dav*. Mon. Br. Permian Fossils, p. 27, pl. ii, figs. 28—31, 1858.

Spec. Char. Shell small, globular or rhomboidal, either transverse or slightly elongated, entirely smooth up to a certain age. Dorsal valve rather more convex than the ventral one, with a fold of moderate elevation, which, commencing at about the middle of the shell, remains smooth or becomes divided into two or three (rarely four) angular ribs; the lateral portions of the valve are entirely smooth, or possess one or two short ribs on either side, close to the margin. The dorsal valve presents a rather deepened sinus, which, commencing at about the middle of the shell, extends to the front, with one or two short ribs along its middle; the beak is small and incurved, but showing between its extremity and the hinge line a small foramenal aperture. No marginal expansions; shell structure impunctate. Dimensions variable; three examples measured—

Length $5\frac{1}{2}$, width 6, depth 4 lines.
„ 5 „ $4\frac{1}{2}$, „ 3 „
„ $2\frac{1}{4}$ „ 2, „ $1\frac{1}{2}$ „

Obs. After a lengthened comparison of numerous specimens of Phillips's *Terebratula rhomboidea* and *T. seminula*, it appeared to me evident that the last was nothing more than a young state of the first, and that neither could be distinguished from the Permian *Camarophoria globulina* of Phillips; the resemblance was indeed so great, that having mixed several specimens of each, it was with some difficulty that they could be afterwards separated. I was not able to expose the interior, but the single longitudinal median line which can be observed through the transparency of the shell, and which extends for a short distance along the back of the beak, leaves no doubt as to the species belonging to the genus *Camarophoria*, and not to that of *Terebratula* or *Rhynchonella*, as was hitherto supposed.

All the description given by Professor Phillips of his *T. rhomboidea* and *T. seminula* is, that the first has "no lateral plaits and perforation minute," while the second has "one lateral plait," and the "perforation is (also) minute;" but although some specimens of *T. rhomboidea* show no lateral ribs, other examples present one or two. The fold is also sometimes entirely smooth, one of Professor Phillips's figures denoting that the author was aware of the fact; and it is to this last variety that Professor M'Coy, at a subsequent period, applied the specific denomination of *Hemithyris longa*. We now, therefore, dispense with three so-termed species, and are able to add another to those that are common to the Carboniferous and Permian periods. In Pl. XXIV, I have represented the original figures, as well as all the principal variations of shape hitherto discovered.

Loc. *Camarophoria globulina* has been found in the Carboniferous limestone of Bolland and Settle, in Yorkshire; at Longnor, in Derbyshire, &c. Mr. Kelly mentions Cookstown, Blacklion, and Howth, as Irish localities. I am not acquainted with any Scottish example. It occurs also in the Permian shell limestone of Tunstall and Humbleton Hills, &c.

Camarophoria (?) laticliva, *M'Coy*. Pl. XXV, figs. 11, 12.

Camarophoria laticliva, *M'Coy*. British Paleozoic Fossils, p. 444, pl. iii D, figs. 20, 21, 1855 (not *Atrypa laticliva*, M'Coy, Carb. Foss. of Ireland, p. 22, fig. 16, 1844).

Spec. Char. Transversely rhomboidal, wide, very deeply trilobed, rounded; both valves convex; mesial fold elevated, sinus deep; beak small, incurved, or adpressed to the umbone of the dorsal valve; foramen small, triangular. Each valve is ornamented with about twelve or thirteen ribs, of which a few have obscurely dichotomised; they originate at a short distance from the extremity of the beaks, and proceed from thence to the margin; three or four compose the fold, two or three the sinus, with wide flattened spaces on either side. One example measured—

Length 10, width 13½, depth 7 lines.

Obs. The above description has been abridged, or partly copied, from that published by Professor M'Coy, in his work on 'British Palæozoic Fossils,' because, from not having been able to obtain specimens of the species, I cannot express an opinion of my own as to its specific value. It is, however, more than probable that the shell which was briefly described, and vaguely represented, by M'Coy, in his 'Synopsis,' under the name of *Atrypa laticliva*, is specifically distinct from the one he subsequently described and figured as *Camarophoria laticliva;* and although I have no means of ascertaining whether the Professor is right while attributing the shell under description to the genus *Camarophoria*, I have reproduced the name and figures under his responsibility alone.

Professor M'Coy states, moreover, that "this species is very remarkable for its few ribs, deep trilobation (accounting for the wide, steep, smooth spaces on each side of the mesial ridges), and the very small beak. The smooth rostral space, free from ridges, extending nearly to the beak, clearly separates this species from *H.* (*R.*) *pleurodon;* and their great size and small number are distinctive characters from *C. ventilabrum*. Some very large specimens from Derbyshire, nearly ten lines long, show an obscure duplication of some of the great ridges near the margin. The very small, depressed sides, wide space free of ridges defining the mesial elevation, and the extremely sharp angular definition of the ridges, separate the species from the obtuse *H.* (*Rh.*) *pugnus*. The mesial septum in the (ventral) valve, in specimens of the above size, is from three to four lines long; the divarication forming the chamber in the beak is very distinct, but remarkably narrow, being upwards of a line long, but considerably less than half a line wide.

"*Position and locality.* Carboniferous limestone, Derbyshire; and Lowich, Northumberland."

Camarophoria isoryncha, *M'Coy*. Pl. XXV, figs. 1, 2.

Atrypa isorhyncha, *M'Coy*. Synopsis of the Characters of the Carboniferous Fossils of Ireland, p. 154, pl. xviii, fig. 8, 1844.
Camarophoria isorhyncha, *M'Coy*. British Palæozic Fossils, p. 444, 1855.

Spec. Char. Obscurely subcuboidal, globose; length, width, and depth, nearly equal; dorsal valve very gibbous, presenting in profile a rising curve, which is most elevated close to the front, where it becomes suddenly deflected (at almost right angles), so as to meet the margin of the opposite valve. The mesial fold is generally composed of four ribs, but does not project very much above the uniform gibbosity of the valve; the lateral portions of the beak and umbone are compressed, flattened, or slightly concave. The ventral valve is of small depth, and slightly convex to within a short distance of the front, when it becomes suddenly bent so as to meet the margin of the opposite valve; sinus

wide and shallow; beak obtuse, not much produced or incurved. The surface of each valve is ornamented with about twenty obtusely angular ribs, which are strongly arched on the lateral portions of the shell.

Length 12½, width 13, depth 13 lines (Sir R. Griffith's specimen).

Obs. This species is stated by Professor M'Coy to be common in red arenaceous limestone, underlying the main limestone of the country, at Cookstown, Tyrone, in Ireland; and the only specimen I have been able to examine is one so labelled by M'Coy, and which forms part of Sir R. Griffith's collection. With such scanty material before me, I cannot venture upon any observations relative to its variations in form, age, and character; but the species seem well distinguished from other Carboniferous *Rhynchonellæ* or *Camarophorias*, by its general appearance. In the 'Synopsis,' Professor M'Coy describes the shell as an *Atrypa*, but at p. 444 of the work on the species of palæozoic fossils in the Cambridge Museum, the author states it to be a *Camarophoria*.

"The mesial septum in the dorsal valve strong, and about half the length of the flattened rostral portion; the mesial septum in the ventral one is nearly as long, and diverges to form a large wide chamber at the beak."

Sir R. Griffith's specimen does not show the interior, but on the external surface of each valve a single median line may be perceived, extending from the extremity of the beak and umbone to about a third of the length of the shell, which would indicate septa which probably supported processes peculiar to *Camarophoria*. We are also informed by Professor M'Coy, that the shell occurs in brownish siliceous Carboniferous rocks, near Shap Toll Bar, in England; and Professor De Koninck believes that the species is to be found in the Carboniferous beds of Tournay, in Belgium. No Scotch example has been recorded.

Family—STROPHOMENIDÆ.

This family comprises several genera and sub-genera, of which *Strophomena*, *Streptorhynchus*, and *Orthis* alone have been found to be represented in British Carboniferous strata. It must however be remarked, that although the families *Strophomenidæ* and *Productidæ* have been the subject of long and patient research, and that much progress has been made towards their elucidation, a great deal still remains to be done before the species of the first will have been grouped together with that degree of precision which is required in similar investigations; for it is certain that when we examine an extensive suit of the species which are at present located in the genera *Strophomena* and *Leptæna*, we perceive much interior dissimilarity, and it would be desirable to group more closely together those that resemble each other, and to separate those that are dissimilar. This, however, is a subject for further consideration, and no good would accrue to science

by the hasty fabrication of a number of new genera on half worked-out material and ideas.[1]

Palæontologists appear to have generally agreed as to the propriety of maintaining the two families above mentioned, but it is still uncertain whether the characters by which they have been distinguished are of the importance at one time imagined. It was once supposed that external spines were peculiar to the *Productidæ*, and always absent in the *Strophomenidæ;* but it is now well known that certain species of *Orthis* were as thickly covered with short slender spines as any of the *Productidæ*—e. g., *P. punctatus*. In external shape also many *Strophomenidæ* differ but little from certain *Productidæ*, but interiorly the absence of the so-termed reniform impressions in all the *Strophomenidæ* hitherto discovered would appear to be the most constant character by which the two families can be distinguished.

In the *Strophomenidæ*, as well as in the *Productidæ*, no very prominent calcified processes have been hitherto detected, for the support of those beautifully fringed appendages which exist on either side of the mouth of the animal, and to which the (improper) designation of "oral arms," or "brachial appendages," has been given by the greater number of naturalists, and which are now believed to have subserved at once the function of gills and of sustentation, and to prove which, as observed by Mr. Hancock, "it is only necessary to refer to the manner in which the blood circles round the arms, and is carried to the cirri, but more particularly to its circulating through these latter organs, and to return direct from them to the heart."

Genus STROPHOMENA, *Rafinesque*, 1820.

Of this genus but a single species is known from the British Carboniferous strata, viz.:

STROPHOMENA RHOMBOIDALIS, *Wahlenberg*, Var. ANALOGA, *Phillips*. Pl. XXVIII, figs. 1, 2.

ANOMITES RHOMBOIDALIS, *Wahlenberg*. Acta. Soc. Ups., vol. iii, p. 65, No. 7, 1821.
PRODUCTA DEPRESSA, *Sowerby*. Min. Conch., pl. cccclix, fig. 3, 1823.
— RUGOSA, *Hisinger*. Vetensk. Acad. Hand. for är. 1826.

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[1] It must be obvious to all, that the present work, whose publication will unavoidably have extended over a number of years, can be fairly viewed but as a continual attempt to work out a great difficulty. Availing myself, as I have constantly done, of every new discovery made by myself or by other competent observers, and imbued with no preconceived idea, I have continually modified my views as science has progressed; and this I must plead as a valid excuse for the changes (contradictory, perhaps) which may be noticed here and there in the many pages of which the monograph is composed. It is, however, my intention (should I ever be able to complete my arduous undertaking) to correct and co-ordinate the whole in the concluding pages.

LEPTÆNA RUGOSA, *Dalman*. Kongl. Vetensk. Handl. for är. 1827, pl. cvi, fig. 1.
PRODUCTUS QUADRANGULARIS, *Steininger*. Bemerk. über die Verstein. des Eifels, p. 35, 1831.
STROPHOMENA PILEOPISIS, *Dumont*. Const. Géol. de la Province de Liège, p. 354, 1832.
— MARSUPIT. Ibid.
PRODUCTUS ELEGANS, *Steininger*. Mém. Soc. Géol. de France, vol. i, p. 361, 1834.
STROPHOMENA RUGOSA, *Bronn*. Lethæa, Geog. i, p. 87, pl. ii, fig. 8, 1835.
PRODUCTA ANALOGA, *Phillips*. Geol. of Yorkshire, vol. ii, p. 215, pl. vii, fig. 10, 1836.
ORTHIS RUGOSA, *V. Buch*. Ueber Delthysis, p. 70, 1837.
LEPTÆNA TENUISTRIATA, *Sowerby*. Sil. Syst., tab. xxii, fig. 2 a, 1838.
— DISTORTA, *J. Sowerby*. Min. Conch., vol. vii, pl. dcxv, fig. 2, 1840.
— NODULOSA, *Phillips*. Palæozoic Fossils of Cornwall, pl. xxiv, fig. 95, 1841.
— DEPRESSA, *De Koninck*. Description des animaux fossiles de la Belgique, pl. xii, fig. 3, 1843.
LEPTAGONIA RUGOSA, *M'Coy*. Synopsis of the Characters of the Carb. Foss. of Ireland, p. 118, 1844 (also 1855).
— MULTIRUGATA, *M'Coy*. Pl. xviii, fig. 12, 1844.
STROPHOMENA RHOMBOIDALIS, var. ANALOGA, *Dav*. Carboniferous System in Scotland. The Geologist, vol. iii, p. 102, pl. i, figs. 26—33, 1860.

Sp. ch. Shell more or less transversely semicircular or sub-quadrate; valves geniculated; hinge line straight, and as long as the greatest width of the shell, with rounded cardinal angles, which are at times prolonged in the shape of expanded wings. The ventral valve is slightly convex at the beak, from whence it becomes flattened to a certain distance and age, when the valve is suddenly bent downwards at almost right angles.. The frontal margin is undulated, concave near the cardinal angles; it afterwards bulges out laterally, to form in front a slight outward curve. On the flattened portion of the disc, there exists a variable number of slightly undulating and occasionally interrupted concentric wrinkles, which turn outwardly towards the cardinal angles, and thus follow the marginal curves. The entire surface is also covered with numerous radiating, thread-like striæ; and a small circular foramen is generally observable close to the extremity of the beak, and up to a certain age, but which becomes obliterated or cicatrised in the adult. The dorsal valve is concave, and usually follows the curves of the opposite one, and is similarly wrinkled and striated. In the interior of the ventral valve, two diverging teeth articulate with corresponding sockets in the opposite valve. The muscular impressions (in this valve) are margined by a semicircular ridge, continued from the base of the teeth, and curving on either side so as to produce a saucer-shaped depression; the adductor or occlusor leaves a scar on either side close to a small median ridge, the cardinal or divaricator muscle filling on either side the anterior portion of the cavity; the ventral adjustor and pedicle muscles do not appear to have produced any very definite impressions, but it is highly probable that an attachment for these muscles existed in the posterior portion of the saucer-shaped depression above described, from the fact that a small circular peduncular foramen is also observable at a small distance from the extremity of the beak, and which

PLATE XVII.

1, 2. ATHYRIS EXPANSA, *Phillips.* Two remarkable malformations from the Carboniferous limestone of Hittor Hill and Longnor, in Derbyshire. Collection of the School of Mines.

3, 4. — — A regular and typical specimen from Settle, in Yorkshire, collection of Mr. Burrow.

5. — — A malformation from the same locality, from the same collection as 1 and 2.

6, 7. — LAMELLOSA, *L'Eveillé.* From the Carboniferous limestone of Settle. In the collection of Mr. Burrow. These specimens are remarkable, as they show that in the dorsal valve there existed first a sinus, which soon became converted into a mesial fold.

8. — SUBTILITA, *Hall.* From near Bolland. British Museum.

9, 10. — — From the Carboniferous limestone of Kendal, in Westmoreland.

11. — AMBIGUA, *Sowerby.* A very large example from Ireland.

12. — — Interior of the dorsal valve (enlarged), from Bakewell. This figure has been completed from several specimens in the Museum of the School of Mines.

13. — — Ventral valve (enlarged) from silicified internal casts, from Bakewell in Derbyshire, and Museum of the School of Mines. A, ADDUCTOR or OCCLUSOR, R, DIVARICATOR, muscular impressions.

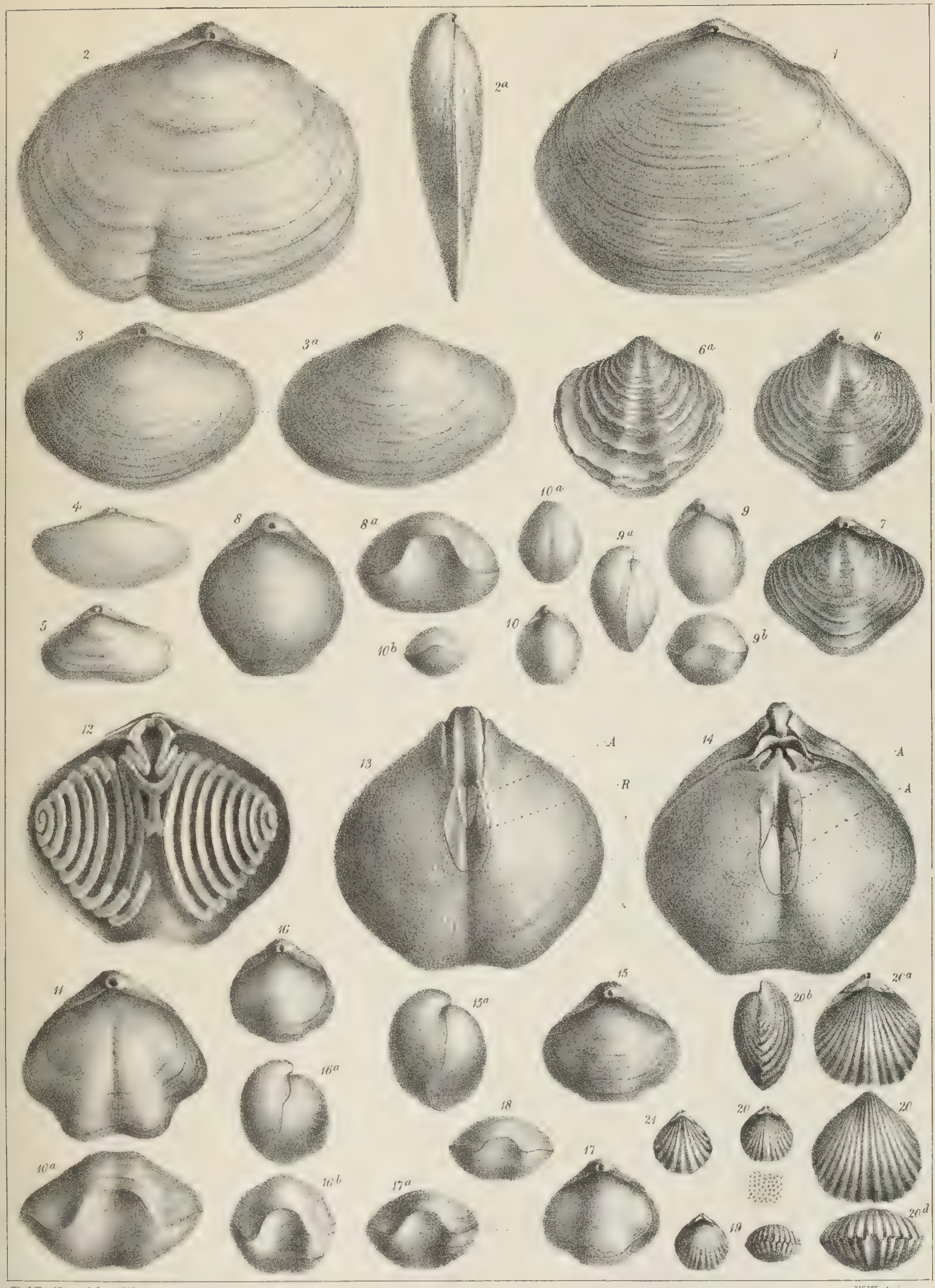
14. — — Dorsal valve of the same specimen as 13. A A, quadruple impression of the adductor or occlusor muscle.

15. — GLOBULARIS, *Phillips.* From the Carboniferous limestone of Bolland, and Phillips's original specimen in the British Museum.

16, 17, 18. — — From Settle in Yorkshire, collection of Mr. Burrow.

19. RETZIA RADIALIS, *Phillips.* From the original specimen in the British Museum. Bolland.

20, 21. — — From Settle, Yorkshire. Collection of Mr. Burrow.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20d

PLATE XVIII.

1. Athyris Royssii, *L'Eveillé.* This figure represents the original example of Phillips's *Spirifera glabristria,* from the Carboniferous limestone of Bolland. British Museum. The outer layer of the shell, with its spiny investment, is absent.

3—7. — — From Millecent, Ireland. The outer layer of the shell is absent.

8—10. — — Three specimens showing a portion of the spiny investment, from Carboniferous shales. Ulverstone, fig. 11, being an enlarged representation, to better explain the character of the spines.

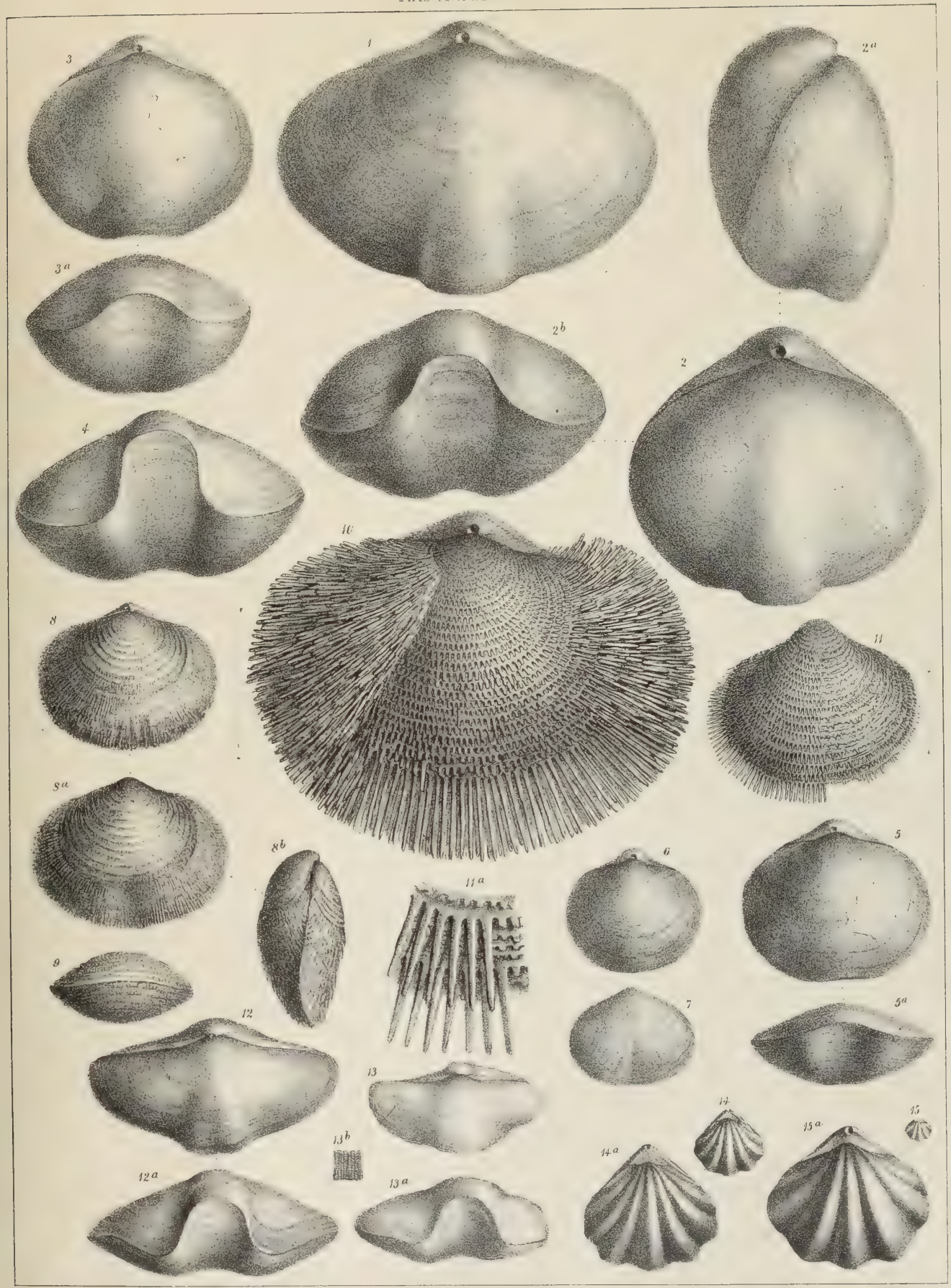
11. — — This is drawn from Phillips's original example of *Sp. fimbriata,* and was communicated by the author.

12. — squamigera, *De Koninck.* From the Carboniferous limestone of Millecent in Ireland. I have seen many examples of this shell from both Ireland and England; and Prof. de Koninck, to whom I communicated specimens, believes that it might perhaps be referable to his species. The outer or reticulated surface of the shell is, however, absent.

13. — — From the Carboniferous limestone of Ballina, County Dungarvan, Ireland. In the collection of Sir R. Griffith. This is the specimen which Prof. M'Coy described (in his 'Synopsis'), as the *Martinia phalæna* of Phillips, but beside not being a spirifer, it does not belong to Phillips's Devonian shell. 13 shows a small portion of the imbricated surface.

14. Retzia Ulstrix, *De Koninck.* From the Carboniferous limestone of Bolland. British Museum.

15. — — From the Carboniferous limestone of Wetton, in Derbyshire, and collection of the School of Mines. This shell has been identified by Prof. de Koninck as belonging to his species.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13b
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15a
14a
12a
13a

PLATE XIX.

1. RHYNCHONELLA RENIFORMIS, *Sowerby*. A large example from the Carboniferous limestone of Kildare in Ireland, with three ribs on the mesial fold.

2. — — In the collection of Mr. E. Wood, with four ribs on the mesial fold.

3, 7. — — Different specimens from Millecent, in Ireland; fig. 4 alone being from Castleton, in Derbyshire, and collection of Dr. Bowerbank.

8. — CORDIFORMIS, *Sowerby*. From the original example in the collection of Mr. J. de C. Sowerby.

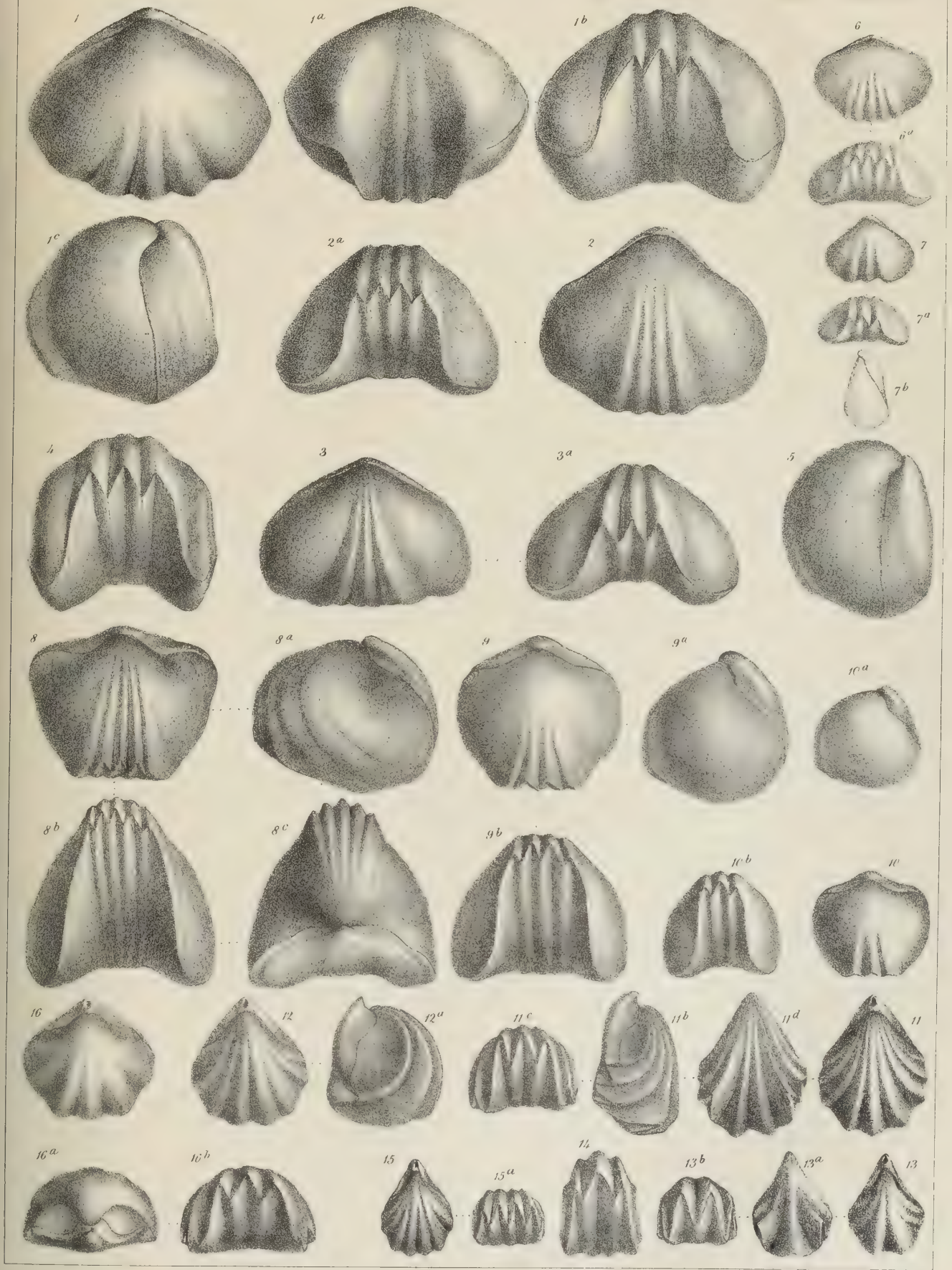
9, 10. — ? From the Carboniferous limestone of Kildare, in Ireland.

11, 13, 14, 15. — ANGULATA, *Linnæus*, sp. From the Carboniferous limestone of the Isle of Man, in the collection of the Rev. J. G. Cumming.

12. — — From Yorkshire, in the collection of the School of Mines.

16. — — From Settle, in Yorkshire, in the collection of Mr. Burrow.

N.B. This series illustrates the variations in number of the ribs.



Tho^{s} Davidson del & lith.

W West imp

PLATE XX.

1, 2. RHYNCHONELLA ACUMINATA, *Martin*, sp. Typical shape. Carboniferous limestone, Clitheroe, Lancashire. Gilbertsonian Collection. British Museum.

3. — — From the Isle of Man, and collection of the Rev. J. G. Cumming.

4. — — From Park Hill, Longnor, Derbyshire, and collection of the School of Mines.

5, 7, 8. — — From Settle, in Yorkshire. Collection of Mr. Burrow.

6. — — Interior of the dorsal valve.

9, 10. — — Isle of Man. Collection of the Rev. J. G. Cumming.

11. — — From Yorkshire. Collection of Mr. E. Wood.

13. — — From Kildare, in the collection of Professor Phillips.

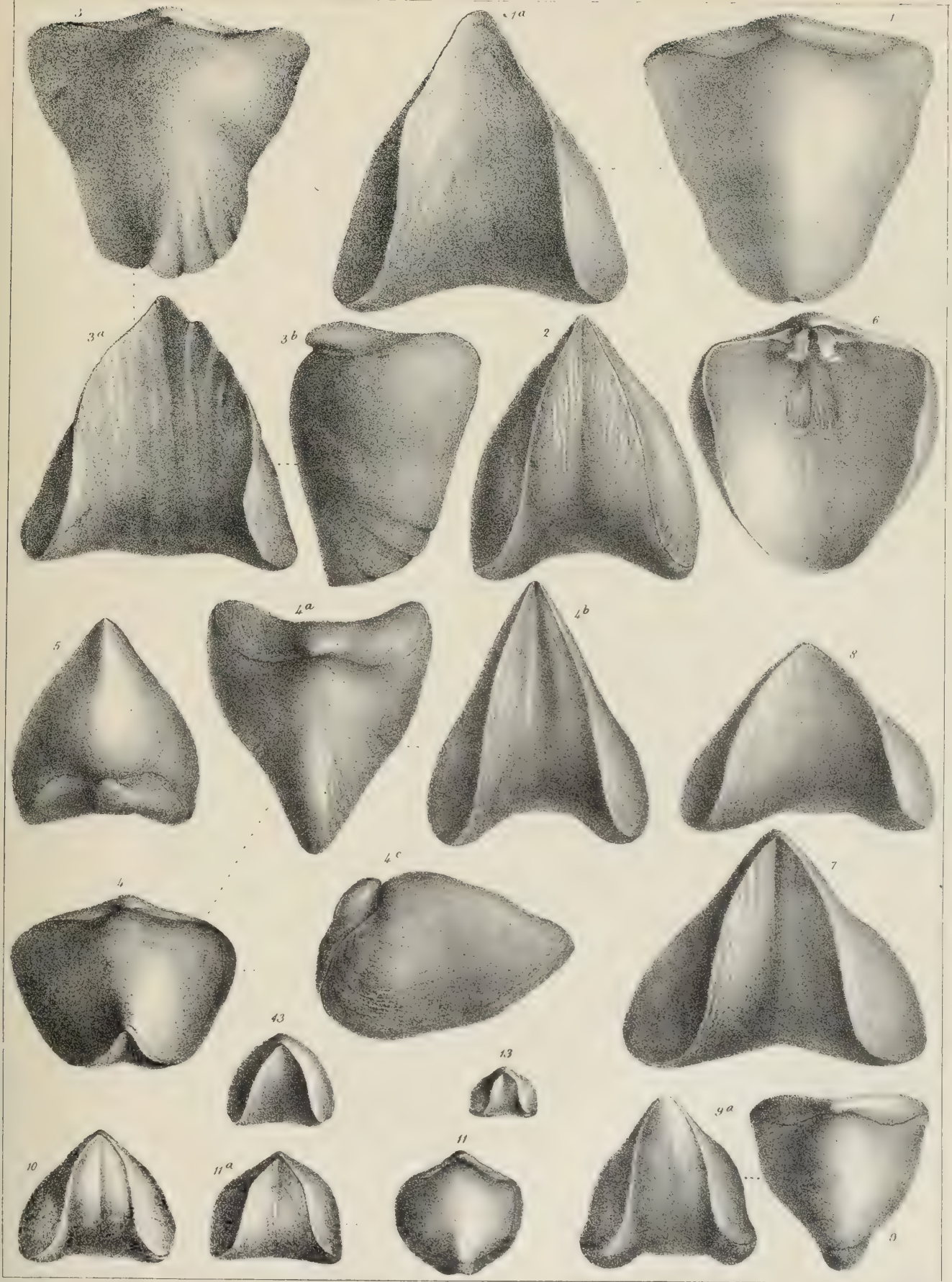


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PLATE XXI.

1. RHYNCHONELLA ACUMINATA, var. MESOGONIA, *Phillips*. From the Carboniferous limestone of Clitheroe.

2. — — From the same locality. Gilbertsonian collection. British Museum.

3. — — var. with two ribs on the fold; same collection and locality.

4 — 13. — — var. *plicata*. A number of variations in shape more or less plicated, from Clitheroe. Gilbertsonian collection. British Museum.

14 — 20. — — var. *platiloba*, Sowerby. From Clitheroe and Kildare.

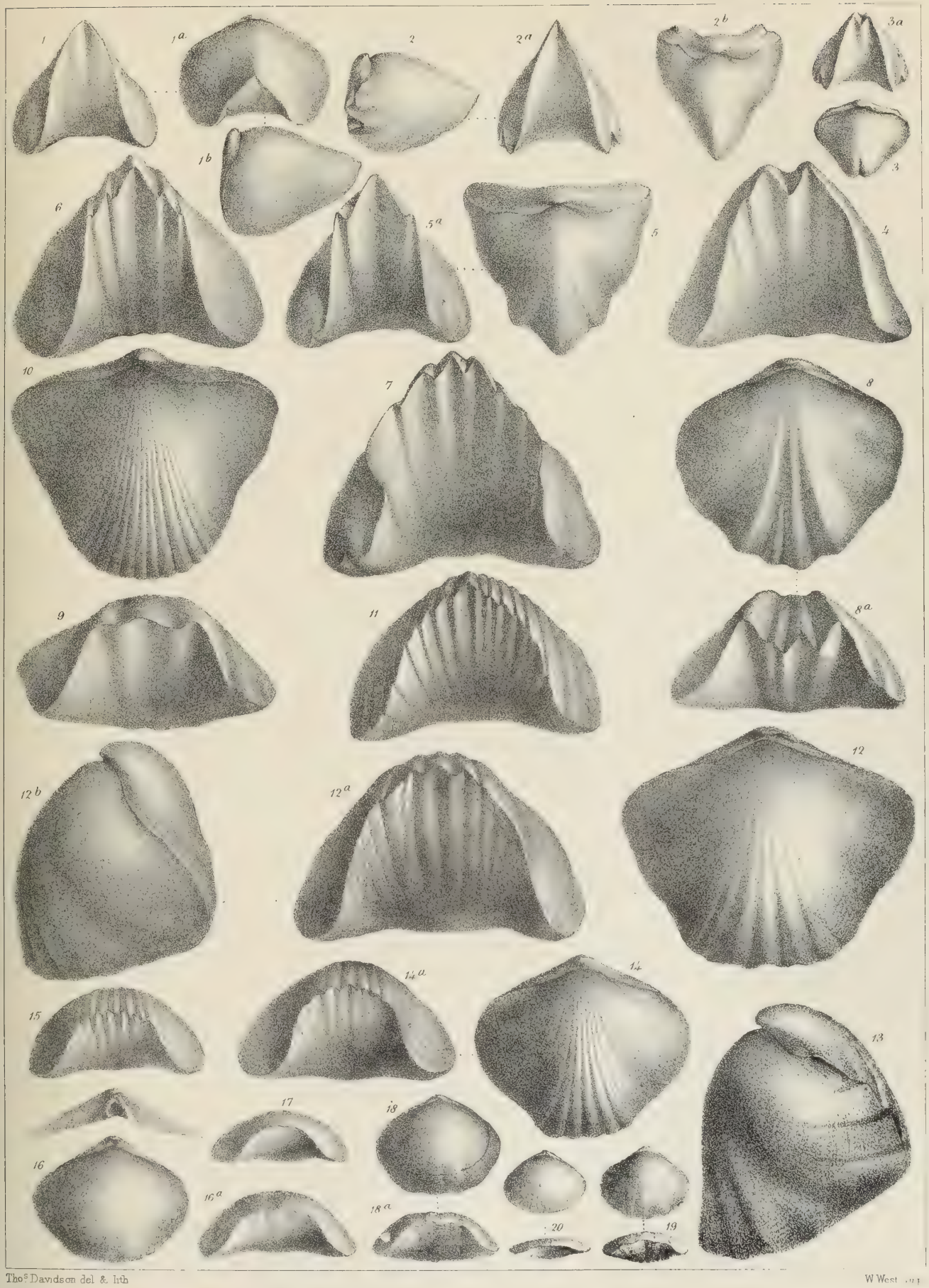

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PLATE XXII.

1. Rhynchonella pugnus, *Martin*, sp. From the original specimen. now in the collection of Mr. J. de C. Sowerby. Carboniferous limestone of Castleton.

2. — — From near Bolland. This is the average size of specimens.

3, 4. — — Two enormously large examples from Linton, in the Craven district, Gilbertsonian Collection, British Museum. One figure of each of these specimens was given in the 'Geology of Yorkshire;' they are the largest examples of the species hitherto discovered.

5, 6. — — Two large specimens from Linton, in the collection of Mr. J. de C. Sowerby.

7, 8. — — Front view of two Yorkshire specimens in the British Museum.

9—12. — — From Clitheroe; young shells.

13 — — Interior of the dorsal valve.

14. — — From Carluke parish, Lanarkshire.

15. — — *Ter. sulcirostris*, Phillips. After the figure in the 'Geology of Yorkshire.'

16. — — *Atrypa laticliva*, M'Coy. From the figure in the 'Synopsis.'

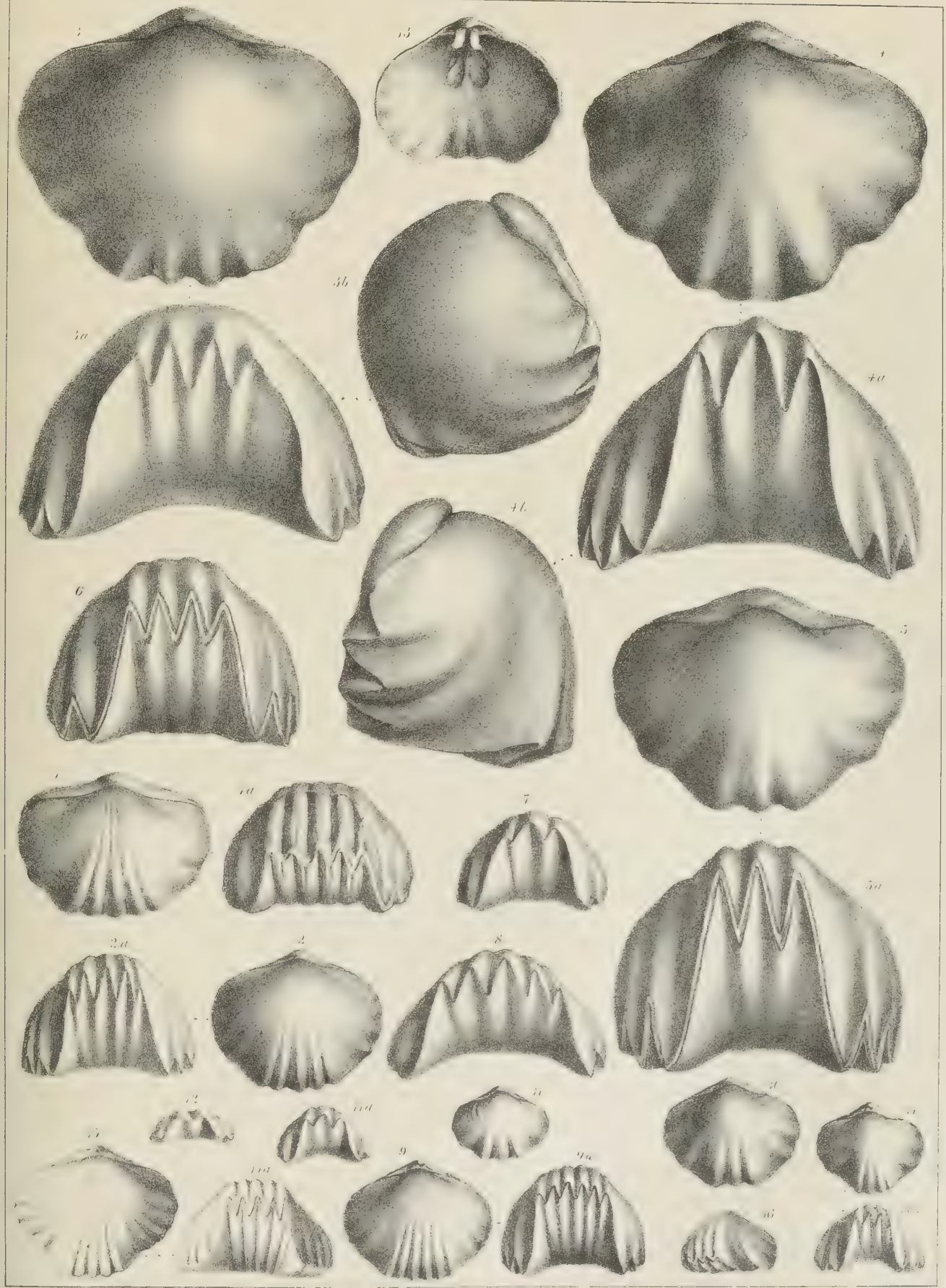

PLATE XXIII.

1, 2.	Rhynchonella pleurodon, *Phillips*.		From the Carboniferous limestone of Bolland.
3—5.	—	—	From Bolland and Settle.
6.	—	—	A specimen with nine ribs on the mesial fold. Bolland. British Museum.
7.	—	—	From Kerry, Ireland.
8—11.	—	—	Young shells from Settle, in Yorkshire.
12.	—	—	A globose variety, in which the ribs do not attain the extremity of the beaks.
13, 14.	—	—	var. *T. ventilabrum*, Phillips. After the figure in the 'Geology of Yorkshire.'
15.	—	—	= *Terebratula Mantiæ*, Sow. From the original specimen in the collection of Mr. J. de C. Sowerby. It is a malformation of *Rh. pleurodon*.
16.	—	—	var. *triplex*, M'Coy. From the Carboniferous shale, near Carluke, Lanarkshire, Scotland.
17.	—	—	From Professor M'Coy's type of *A. triplex*.
18.	—	—	A malformation, the sinus being twisted to one side. Carluke.
19—21.	—	—	var. *Davreuxiana*, De Koninck. Carboniferous limestone, Gilling, Yorkshire, in the collection of Mr. E. Wood.
22.	—	?	From the Carboniferous limestone of Twiston, Lancashire, and collection of Mr. Parker. I am uncertain as to the species to which this remarkable specimen should be referred, a single example only having been hitherto discovered.

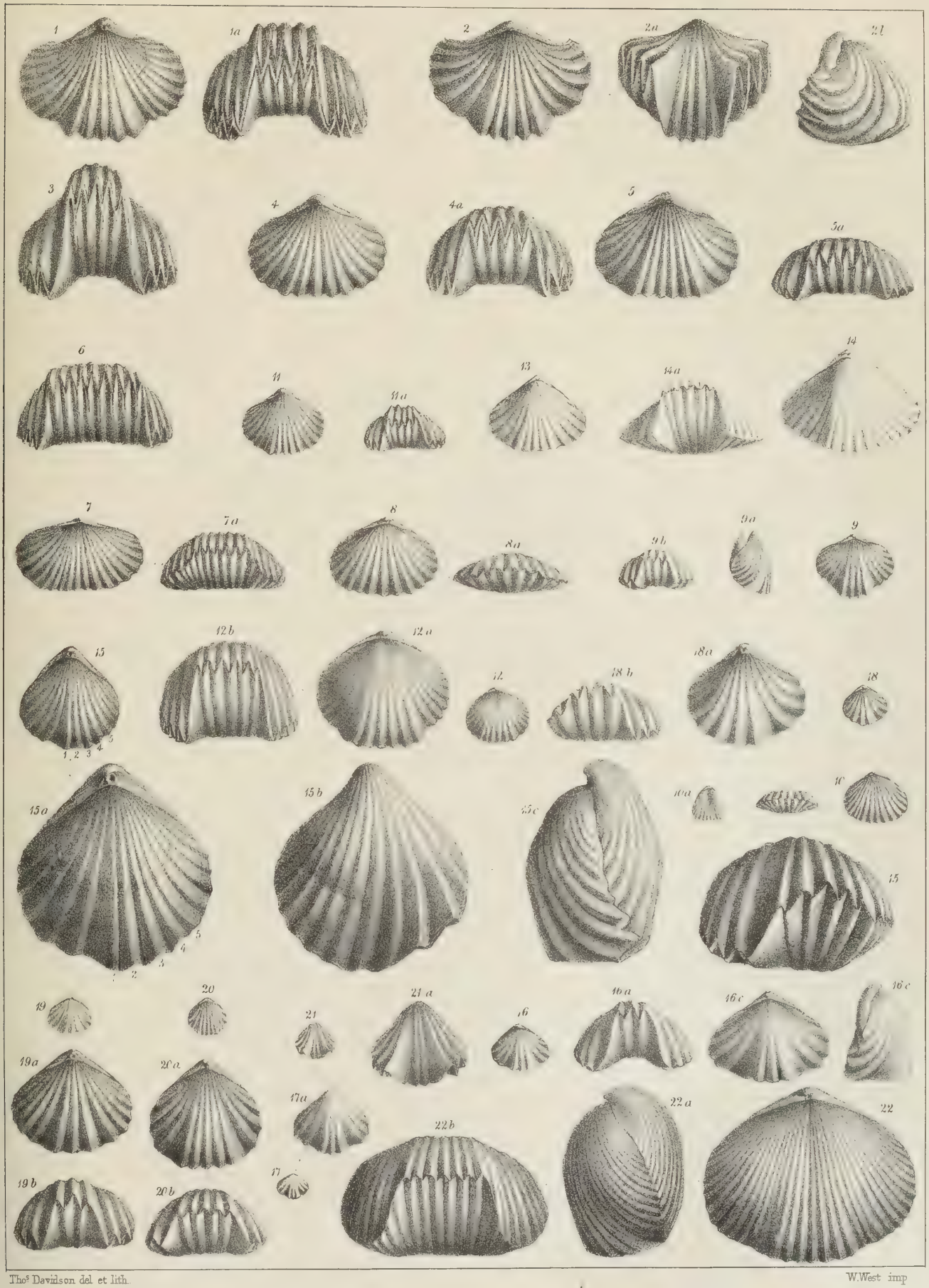

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PLATE XXIV.

1. Rhynchonella flexistiria, *Phillips.* = *T. tumida*, Phillips. From the original figure, 'Geology of Yorkshire,' tab. 12, fig. 35.

2. — — A very fine specimen from the Carboniferous limestone of Clitheroe, and collection of Mr. M. Parker.

3. — — From Phillips's original specimen of *T. tumida*, British Museum. Bolland.

4. — — From Millecent, Ireland.

5. — — = *Rh. heteroplycha*, M'Coy. 'British Palæozoic Fossils,' tab. 3 D, fig. 19.

6. — — From Professor Phillips's original specimen, *T. flexistria*. Bolland. British Museum.

7, — — From Professor Phillips's figure of *T. flexistria*, 'Geology of Yorkshire,' tab. 12, figs. 33, 34. This was not very correctly drawn in the work last mentioned: fig. 6 of our plate is a more correct representation.

8. — — From Bolland. A curious variety. A careful examination of the specimens, figs. 1 to 8, leads me to believe that they are all referable to a single species.

9, 10. Camarophoria globulina, *Phillips*, var. *rhomboida*, Phillips. From tab. 12, figs. 18, 19, 20, of the 'Geology of Yorkshire,' and Carboniferous limestone of Bolland.

11, 12. — — Two specimens from the Bolland district and British Museum. I believe the example, fig. 12, to be the original specimen on which Phillips's *T. rhomboida* was founded.

13, 14. — — *T. seminula*, Phillips's 'Geology of Yorkshire,' tab. 12, figs. 21—23.

15, 16. — — Were drawn from Phillips's original specimen of *T. seminula*. Carboniferous limestone. Bolland district. British Museum. It appears to me that *T. seminula* is the fry or young of *T. rhomboida*, Phillips; and this last is, to all appearance, the same as the Permian *C. globulina*.

17. — — *Rh. longa*, in M'Coy's 'British Palæozoic Fossils,' pl. 3 D, fig. 24.

18—22. — — Different specimens and varieties from the Carboniferous limestone of Longnor, in Derbyshire.

23—25. Rhynchonella ? trilatera, *De Koninck*. From the Carboniferous limestone of Derbyshire. British Museum.

26. — — From the Carboniferous limestone of Alstonfield. Museum of Practical Geology.

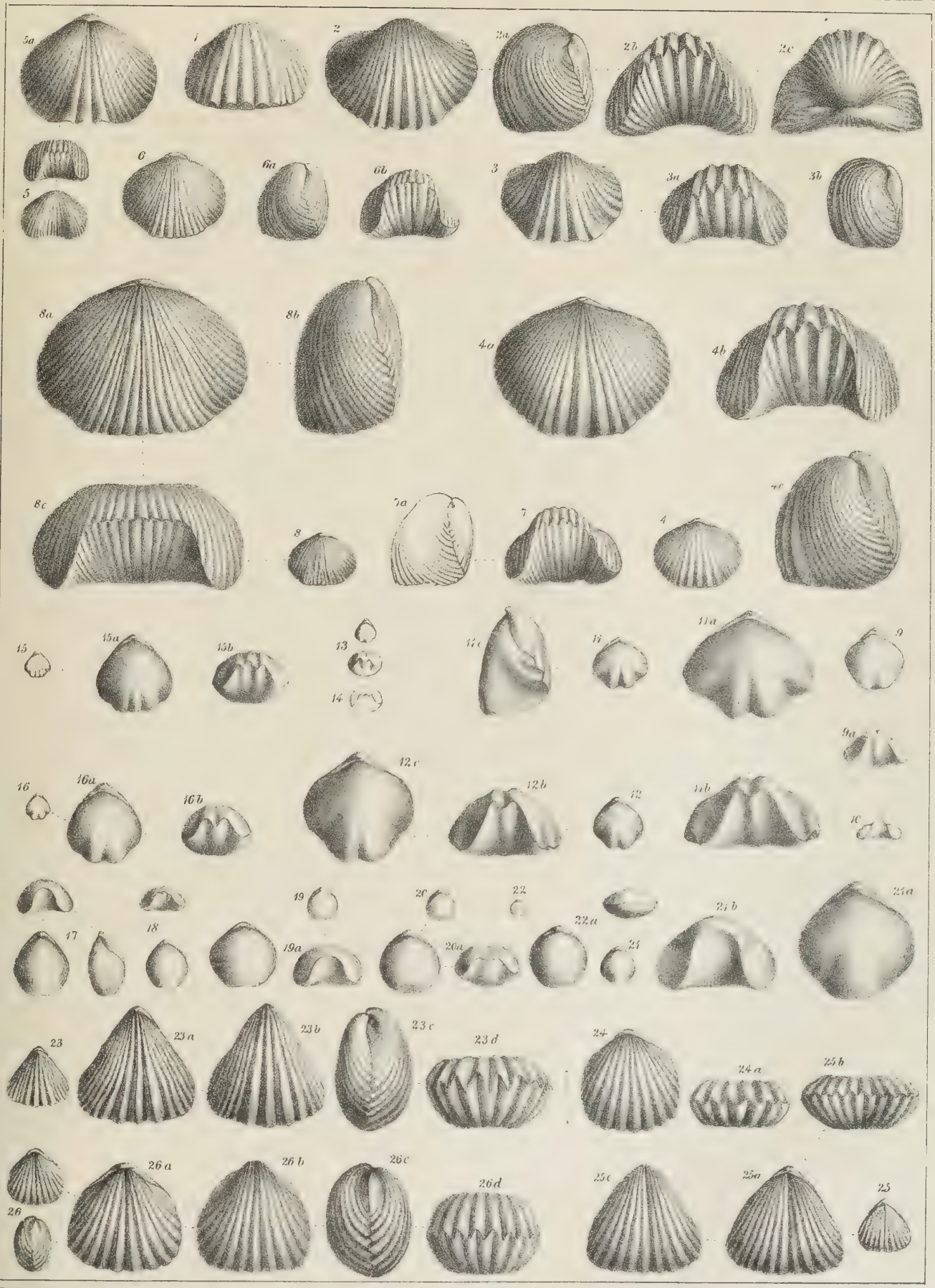

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PLATE XXV.

1. CAMAROPHORIA ? ISORHYNCHA, *M'Coy*. From the Carboniferous limestone of Cookstown, Tyrone, Ireland; and collection of Sir R. Griffith.

2. — — From M'Coy's figure in the 'Synopsis of the Carboniferous Fossils of Ireland,' tab. 18, fig. 8.

3. CAMAROPHORIA CRUMENA, *Martin*. Sp. 'Petrif. Derb.,' tab. 36, fig. 4. Carboniferous limestone of Derbyshire.

4. — — From Settle, Yorkshire.

5. — — From West Lothian, Scotland. Collection of the late Dr. Fleming.

6. — — From the Carboniferous limestone of Dovedale, Derbyshire, and Museum of Practical Geology.

7, 8. — — From Settle, Yorkshire.

9. — — From Bolland. British Museum. This series of specimens or figures illustrates the variation in the number of ribs on the mesial fold.

10. CAMAROPHORIA ? PROAVA, *Phillips*. From the original specimen in the British Museum. It is, however, uncertain whether this specimen belongs to the genus *Camarophoria*, and whether it may not be specifically the same, but an exceptional shape of *C. crumena*.

11, 12. CAMAROPHORIA ? or RHYNCHONELLA ? LATICLIVA, *M'Coy*. 'British Palæozoic Fossils,' tab. 3D, figs. 20, 21.

13. RHYNCHONELLA ? SEMISULCATA, *M'Coy*. 'Synopsis of the Carboniferous Fossils of Ireland,' tab. 22, fig. 15. Walterstown, Skreen, Ireland. May not this belong to the same species as *Rh. proava*, Phillips?

14. RHYNCHONELLA LATERALIS, *Sow.*, 'Min. Con.,' tab. 83, fig. 1.

15. — NANA, *M'Coy*. 'Synopsis of the Carboniferous Fossils of Ireland,' tab. 23, fig. 19. Rahoran, Ireland.

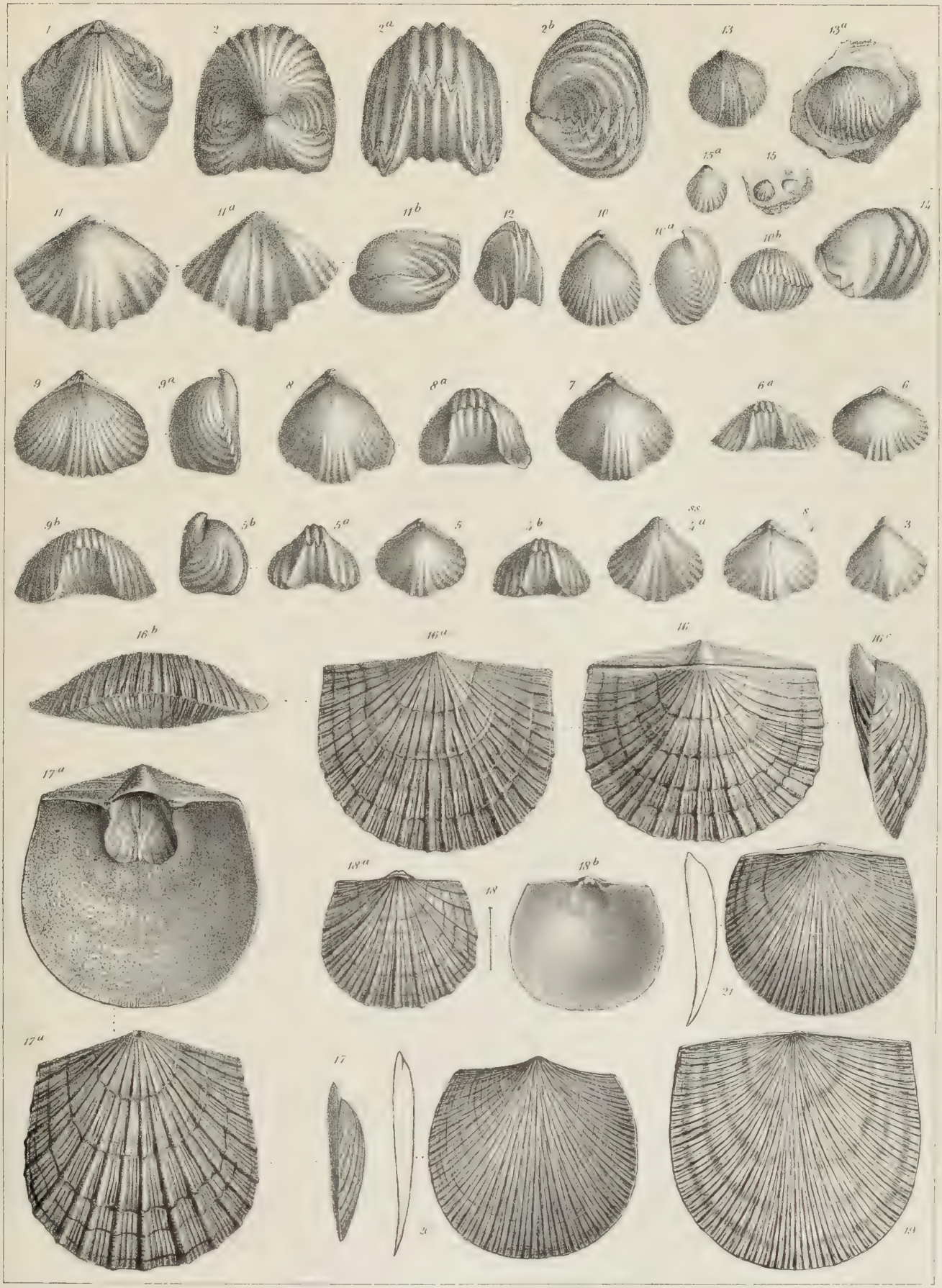
16. STREPTORHYNCHUS CRENISTRIA, Var. *Radialis, Phillips*. From the Carboniferous limestone of Whatley, near Frome, Somersetshire. British Museum.

17, 18. — — From Gare, in Lanarkshire, Scotland. 17A, interior of the ventral valve; 18A, interior of the dorsal valve.

19. — — Var. *Arachnoidea*, Phillips 'Geol. of Yorkshire,' Pl. II. fig. 4.

20. — — In Sandstone at Haltwhistle, from a specimen in the collection of Professor Phillips.

21. — — From Rutchugh, Northumberland. Similar specimens occur in the Kildress red sandstone.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19

PLATE XXVI.

1. STREPTORHYNCHUS CRENISTRIA, *Phillips*. A very large example from the Carboniferous limestone of Kendal, in the collection of the Geological Society.

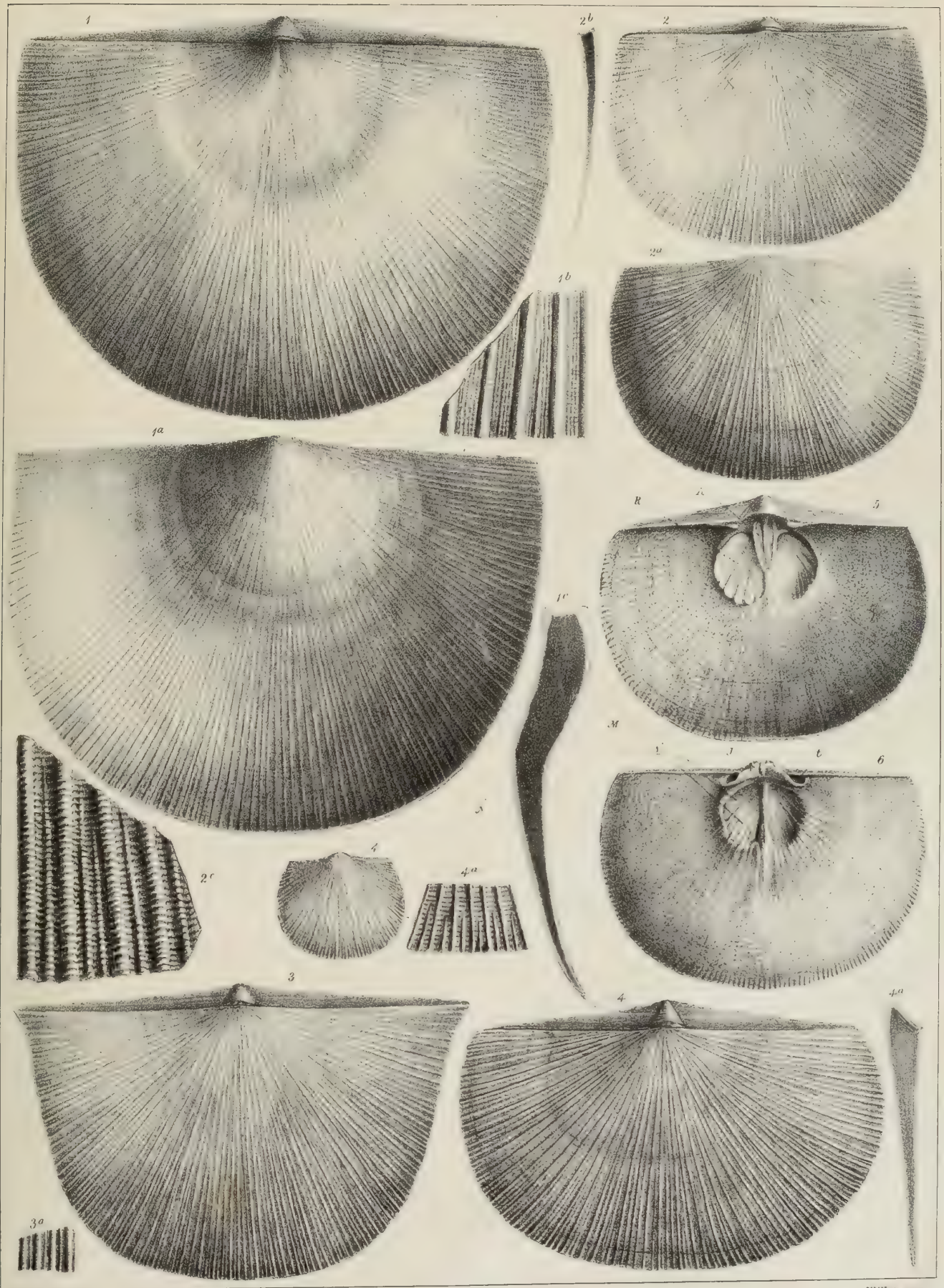
2. — — From Denwell, Northumberland, and collection of Mr. Tate. 2a, a fragment of the shell magnified.

3. — — From the Carboniferous limestone of Lime-kilns above Queensferry, Fifeshire, and collection of the late H. Miller.

4. — — = *O. caduca*, M'Coy. 'Synopsis,' tab. 22, fig. 6. I have examined the original example, which is nothing more than a flattened valve of *A. crenistria*. From Rahoran, Fivemiletown, Ireland, and collection of Sir R. Griffith.

5. — — Interior of the ventral valve from the Carboniferous shell of Hook Point, county of Wexford, in the collection of the Geological Society.

6. — — Interior of the dorsal valve, from Denwell, Northumberland, collection of Mr. G. Tate.



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